

2010 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report for the Lower Platte River, Nebraska



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Monitoring, Research, Management, and Outreach
Report
For the Lower Platte River, Nebraska

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Recommended citation

Brown, M.B., and J.G. Jorgensen. 2010. 2010 Interior Least Tern and Piping Plover Monitoring, Research, Management, and Outreach Report For the Lower Platte River, Nebraska. Joint report of the Tern and Plover Conservation Partnership and the Nongame Bird Program at the Nebraska Game and Parks Commission. Lincoln, NE.

Acknowledgements

Generous financial support for the monitoring, research, management, and outreach activities described in this report was provided by the Nebraska Environmental Trust, Nebraska Game and Parks Commission, Nebraska Game and Parks Commission Wildlife Conservation Fund, Nebraska Natural Legacy Project, Nebraska Bird Partnership, Nebraska State Wildlife Grants, Preferred Rocks of Genoa, United States Fish and Wildlife Service, University of Nebraska-School of Natural Resources, and University of Nebraska Extension.



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We extend our thanks to all of the people who work and volunteer with us on this program including: Jason Alexander, A.F. Amos, Rob Anderson, Jamie Bachmann, Stan Benke, Dave Brakenhoff, Mark Brohman, Linda Brown, Bobbi Carpenter, Deb Carpenter, Keith Carroll, Aaron Clark, Lelia Coyne, Katherine Cullen, Kate DeLashumutt, Pat DeStefano, Mark Dietz, Kenny Dinan, Lauren Dinan, Rick Eades, Dee Ebbeka, Dave Eigsti, Ruth Eigsti, Lois Ericson, T.J. Fontaine, Jolene Foster, Kathy French, Oren Garbisch, Belinda Gillam, Cheri Gratto-Trevor, Matt Gruntarod, Sue Guild, Robert Harms, Greg Hartel, Steve Hartung, Wayne Hathaway, Deb Hauswald, Harry Heafer, Berlin Heck, Alice Heckman, Leslie Hershberger, Jeremy Hiller, Tim Hiller, Caroline Hinkelman, Les Howard, Gregg Hutchison, Kelly Irvin, Paul Johnsgard, Richard Karow, Tim Knott, Michelle Koch, Ron Kruml, Mark Kuzila, Jeanine Lackey, Jill Liske-Clark, Brandy Lively, Sidney Maddock, Annabel Major, John Marinovich, Melissa Marinovich, Courtney McCusker, Jamie McFadden, Peter Melcher, Bruce Mellberg, Brad Mellema, Jeff Nothwehr, Melissa Panella, Gary Pearson, Sue Ellen Pegg, Richard Plumtree, Kevin Poague, Kelly Powell, Diane Pratt, Katie Robinson, Lindsay Rogers, Jeff Runge, Chris Runk, Oscar Sarafin, Joel Sartore, Rick Schneider, Kirk Schroeder, Ross Silcock, Jenn Simons, Rachel Simpson, Meghan Sittler, Sonya Steckler, Kristal Stoner, Bill Summerour, Martha Tacha, Rich Tesar, Chris Thody, Dave Titterington, Drew Tyre, Susan Vosler, Darrin Welchert, Ben Wheeler, Carol White, Don Wilhite, Sara Yendra, Ron Zelt, and Kenton Zimmer.

We extend our thanks to all of our partners including: Arps Gravel and Concrete, Big Sandy Homeowners' Association, Cedar Creek Homeowners' Association, Central Nebraska Public Power and Irrigation District, Central Sand and Gravel, Dial Development, Five Nines Technology Group, Girl Scouts-Spirit of Nebraska, Hallett Materials, HarWest Industrial Minerals, Lake Socorro Homeowners' Association, Legacy Resources, Loup Public Power District, Lower Platte North Natural Resources District, Lower Platte River Corridor Alliance, Lower Platte South Natural Resources District, Lyman-Richey, Mallard Landing Homeowners' Association, Mallard Sand and

Gravel, Nebraska Natural Legacy Project, Nebraska Nature and Visitors' Center, Nebraska Public Power District, Old Castle Materials, Overland Sand and Gravel, PACE, Papio-Missouri Natural Resources District, Paulsen Sand and Gravel, Platte River Recovery Implementation Program, Preferred Rocks of Genoa, Riverview Shores Homeowners' Association, Stalp Sand and Gravel, Tri-County Sand and Gravel, Ulrich Sand and Gravel, United States Army Corps of Engineers, United States Geological Survey, and Western Sand and Gravel.



Preface

This document reports on our monitoring, research, management, and outreach activities during the past 12 months (2010). We prepared it to inform our partners, cooperating agencies, funding sources, and other interested parties of our activities and to provide a preliminary summary of our results.

The data, data analyses, results, summaries, and interpretations found in this document are not final and should be considered as such when being cited or referred to in documents, reports, proposals, or presentations. Please contact us before using any of this material and for additional information that may have become available.

In an effort to make the information in this document more accessible, it is divided into five (5) sections: Introduction, Monitoring, Research, Management, and Outreach.

Introduction: This section describes the project area and summarizes conditions encountered during the 2010 field season.

Monitoring: This section describes the data we collect every year for basic demographic analysis and includes the number of nests, adults, eggs, chicks, and fledglings found in the focus area. These data are collected and summarized in a form that allows comparison across the range of each species.

Research: This section describes our research objectives, data collection, and data analyses.

Management: This section describes our actions to protect Interior Least Terns and Piping Plovers and their nests from interference.

Outreach: This section describes our efforts to increase public awareness and understanding of Interior Least Terns and Piping Plovers and to promote environmental literacy.

The following icons are used on maps to designate nest locations.



Interior Least Tern nest



Piping Plover nest

“Fortunately protection has come in time to save this beautiful species from complete extermination with which it certainly was threatened.”

Arthur Cleveland Bent
Life Histories of North American Gulls and Terns

Introduction

The Tern and Plover Conservation Partnership (TPCP), based at the University of Nebraska-School of Natural Resources, and the Nongame Bird Program (NBP), based at the Nebraska Game and Parks Commission (NGPC), work cooperatively on Interior Least Tern and Piping Plover monitoring, research, management, and outreach in Nebraska. While the focus of our work is the Lower Platte, Loup, and Elkhorn Rivers in the eastern part of the state, we address tern and plover issues across the state and region. Our joint program includes terns and plovers nesting in on-river habitats (midstream river sandbars) and in off-river human-created habitats (sand and gravel mines and lakeshore housing developments). The TPCP leads our efforts at off-river habitats; the NBP leads our efforts at on-river habitats.



Focus Animals

The Interior Least Tern (*Sternula antillarum athalassos*) is a state and federally listed endangered species (50 Federal Register 21784–21792). Terns were placed on the Endangered Species List on 27 June 1985, and a Recovery Plan was issued in September 1990. The listing status of this species is managed under the auspices of the Federal Endangered Species Act (1973) and the Nebraska Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. § 37-801 -11). The Least Tern was first described as a species in 1847 from a type specimen collected in Guadeloupe, West Indies (Checklist of the Birds of North America 1998. American Ornithologists' Union). A 5-year review of the species' recovery status was initiated in 2009 and is expected to be completed in 2011 (J. Ledwin, pers. comm.).

The Piping Plover (*Charadrius melodus*) is a state and federally listed threatened species (50 Federal Register 50726–50734). The species was placed on the Endangered Species List on 10 January 1986, and the Northern Great Plains Recovery Plan was issued in May 1988. The listing status of this species is managed under the auspices of the Federal Endangered Species Act (1973) and the Nebraska Nongame and Endangered Species Conservation Act (Neb. Rev. Stat. § 37-801 -11). Critical habitat for the Northern Great Plains breeding population was designated in Montana, Nebraska, South Dakota, and Minnesota on 11 September 2002 (67 Federal Register 57637). The United States District Court vacated the portion of critical habitat located in Nebraska on 13 October 2005; to date, it has not been reinstated. Piping Plovers were first described as a species in 1824 from a type specimen collected in New Jersey (Checklist of the Birds of North America, 1998, American Ornithologists' Union). A 5-year review of the species' recovery status was completed in 2009, and a revision of the Recovery Plan is being prepared.

Interior Least Terns and Piping Plovers are an integral part of the fauna of Nebraska. There are numerous references to them in Native American culture (e.g., *ūt* is the word for plover in the Pawnee language). They were frequently seen by early explorers and pioneers who passed through the region. Meriwether Lewis and William Clark observed Least Terns in what became the state of Nebraska on their 1803–1805 “Voyage of Discovery”, referring to them as a ‘frequently observed bird’. Terns were the first new bird species noted by Lewis and Clark; on 5 August 1804 they saw a tern flying above the Missouri River in present-day Washington County, Nebraska. Clark wrote in his journal about terns, noting that “this bird is very noysey when flying which it dose extremely swift the motion of the wing is much like that of Kildee it has two notes like the squaking of a small pig only on reather a higher kee, and the other kit’-tee’-kit’-tee’—as near as letters can express the sound.” Lewis and Clark also observed Piping Plovers in what became the state of Nebraska, referring to them in their journals as ‘small kildee’. Artist John James Audubon traveled along the Missouri River and through the Nebraska Territory in 1843. He reported seeing Least Terns near the confluence of the Vermillion and Missouri Rivers, in present day Dixon County, Nebraska. In 1820, members of the Major Stephen Long Expedition found Least Terns nesting along the Missouri River in present-day Washington County, Nebraska. In 1823, Paul Wilhelm, the Duke of Wurttemberg, reported finding Least Terns nesting on sandbars near the mouth of the Platte River in present day Cass County, Nebraska. Members of the Gouverneur Kemble Warren Expedition (1855–1857) reported finding Least Terns and Piping Plovers nesting on sandbars near the confluence of the Loup and Platte Rivers (an area they called the Loup Fork), in present day Platte County, Nebraska. Ferdinand Hayden, traveling with the Warren Expedition, commented that Least Terns and Piping Plovers were very abundant and nested on sandbars in the Platte River. Least Terns were reported, in 1859, to be nesting along the North Platte River, east of Ash Hollow, in Keith County. Reports from the 1860s and 1870s indicate that Least Terns were nesting in Cedar, Dixon, Lancaster, and Sarpy counties; Piping Plovers were reported nesting in Dakota, Dixon, Sarpy, and Wayne counties during this period.

The Great Plains populations of both species have declined due to the broad-scale alteration of the natural river systems and the corresponding loss of nesting habitat. Terns and plovers rely on expanses of bare or sparsely-vegetated sand for nesting habitat; this includes midstream river sandbars and areas that are created by industrial or commercial activities. The amount of river sandbar nesting habitat has been reduced by invasive plant species, construction of dams and reservoirs, river channelization, bank stabilization, island armoring, hydropower generation, and water diversion.

Loss of overwintering habitat has also contributed to both species' declines. Overwintering habitat for Great Plains Piping Plovers occurs along the United States Atlantic and Gulf Coasts, northeastern Mexican coast, and Caribbean islands. Least Terns winter along coastal areas of

Central and South America. Threats to overwintering habitat include sea level rise due to global climate change and residential, industrial, and commercial development. The 2010 BP-Deepwater Horizon oil spill in the Gulf of Mexico is predicted to have serious consequences for terns and plovers across their ranges. Both species are included in the USFWS list of 38 species that are especially threatened by the oil spill (<http://www.fws.gov>).



Focus Area

Our focus area includes the Lower Platte, Elkhorn, and Loup River systems in eastern Nebraska (Figure 1). The Loup and Elkhorn Rivers are tributaries of the Lower Platte River. We define the Lower Platte River as the 103 river miles lying between the Loup River (near Columbus, Platte County) and Missouri River (near Plattsmouth, Cass County) confluences. River mile 0 is defined as the Missouri-Platte River confluence. The Lower Platte River passes through eight counties (Platte, Colfax, Butler, Dodge, Saunders, Douglas, Sarpy, and Cass) and four Natural Resources Districts (Lower Platte South, Lower Platte North, Papio-Missouri, and Lower Loup).

In the Lower Platte River, on-river habitat includes river sandbars used for nesting and the river channel, which is used for foraging. Off-river (also referred to as human-created) habitat includes sand and gravel mines and lakeshore housing developments. At off-river habitats, the birds use the waste sand piles and beaches for nesting and the pit lakes for foraging. In eastern Nebraska, off-river habitats are rarely found more than three miles from a river, and birds nesting at off-river habitats often travel to the river to forage. See Table 1 for a listing of off-river habitat used by terns and plovers in 2010.

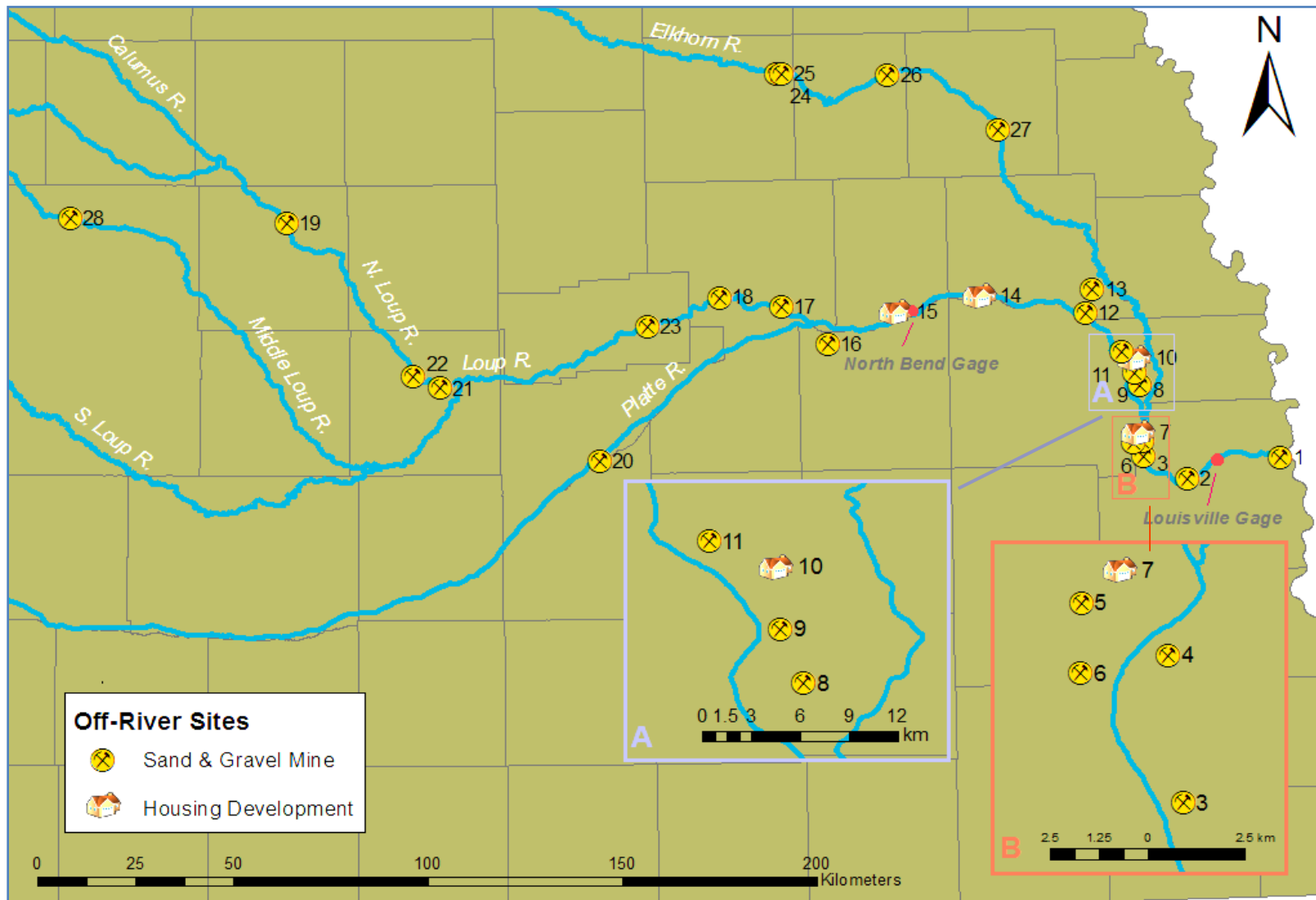


Figure 1. Locations of all known off-river Interior Least Tern and Piping Plover nesting areas in eastern Nebraska. Off-river sites can be matched to numbers in Table 1.

Table 1. Off-river Interior Least Tern and Piping Plover nesting sites; site numbers correspond with Figure 1.

Site	Site Name*	River	Owner	Site Type	County
1	Four Mile Creek (Oreopolis)	Platte	Lyman Richey	Active Mine	Cass
2	Louisville Lakes (Louisville)	Platte	Western Sand and Gravel	Active Mine	Sarpy
3	Linoma Beach (Linoma Beach)	Platte	Lyman Richey	Active Mine	Sarpy
4	Melia (Melia)	Platte	Private	Inactive Mine	Sarpy
5	Riverside (Thomas Lakes)	Platte	Western Sand and Gravel	Active Mine	Saunders
6	NW Riverside (Sand Creek)	Platte	Western Sand and Gravel	Active Mine	Saunders
7	Big Sandy (Big Sandy)	Platte	Homeowners' Association	Housing Development	Saunders
8	OMG-Venice (OMG)	Platte	Old Castle Materials Group	Active Mine	Douglas
9	Lake Clagus (Lyman Richey Waterloo)	Platte	Lyman Richey	Active Mine	Douglas
10	Timber Lake Lodge (Mallard Landing)	Platte	Homeowners' Association	Housing Development	Douglas
11	Pleasure Lake (Lyman Richey Valley)	Platte	Lyman Richey	Inactive Mine	Douglas
12	N Woodcliff (Western Fremont)	Platte	Western Sand and Gravel	Active Mine	Dodge
13	NE Fremont (NE Fremont)	Platte	Lyman Richey	Active Mine	Dodge
14	Riverview Shores (Riverview Shores)	Platte	Homeowners' Association	Housing Development	Dodge

Site	Site Name*	River	Owner	Site Type	County
15	Socorro Lake (Lake Socorro)	Platte	Homeowners' Association	Housing Development	Colfax
16	Wilson Creek (Bellwood)	Platte	Central Sand and Gravel	Active Mine	Butler
17	Shady Lake Road (Columbus)	Loup	Central Sand and Gravel	Active Mine	Platte
18	W Lookingglass Creek WMA (Monroe)	Loup	Central Sand and Gravel	Inactive Mine	Platte
19	Haskell Creek (Ulrich's)	Loup	Ulrich Sand and Gravel	Active Mine	Valley
20	Overland (Central City)	Loup	Overland Sand and Gravel	Active Mine	Hamilton
21	North Loup SRA (North Loup)	Loup	Central Sand and Gravel	Active Mine	Howard
22	E Elba (Tri-County)	Loup	Tri-County Sand and Gravel	Active Mine	Howard
23	LPPD-Genoa Loup Diversion (Sandpile)	Loup	Preferred Rocks of Genoa- LPPD	Active Mine	Nance
24	Medelman's Lake (Medelman's)	Elkhorn	Central Sand and Gravel	Active Mine	Madison
25	Andy's Lake (Andy's)	Elkhorn	Pilger Sand and Gravel	Inactive Mine	Madison
26	Red Fox WMA (Red Fox)	Elkhorn	Pilger Sand and Gravel	Inactive Mine	Stanton
27	Horseshoe Lake (Stalps')	Elkhorn	Stalp Sand and Gravel	Active Mine	Cumming
28	Paulsen Gates (Gates)	Loup	Paulsen Sand and Gravel	Active Mine	Custer

*Site name as recorded on Nebraska Game and Parks Commission (NGPC) database; informal site names are in parentheses.

2010 River Conditions

The amount of sandbar nesting habitat available to terns and plovers varies from year to year. It depends on daily and seasonal fluctuations in the volume of water flowing in the river, annual amounts of rain, ice and snow, ground water levels, and river channel morphology. All of these factors influence sandbar development and maintenance. General flow conditions on the Lower Platte River are monitored by USGS stream gages (<http://waterdata.usgs.gov/ne/nwis/rt>). In addition to these data, we monitor flow conditions by visual inspection of the river at bridge crossings and by direct inspection via canoe and kayak.

River conditions during the 2010 breeding season were characterized by high water and flooding. During May, river conditions were unremarkable, with flows consistently less than 12,000 cfs. Some remnant sandbars, formed during the June 2008 high flow event and used as nesting sites in both 2008 and 2009, were observed in the spring of 2010. Some of these sites, such as RM 38.75 and South Camp Ashland, were used as nesting sites in early 2010 by plovers (both sites) and terns (South Camp Ashland).

In early June, as a result of heavy precipitation throughout the Platte River watershed, flows in the Lower Platte River increased markedly (Figures 2 and 3). River flows peaked at the Louisville USGS gage in mid-June, reaching 114,000 cfs on 14 June 2010. Flows at the North Bend USGS gage peaked the same day, reaching a maximum of 43,400 cfs. Water levels in the Platte River remained high through June.

2010 Off-River Conditions

In 2010, off-river conditions were largely unchanged from 2008 and 2009. The economic recession affected both the sand and gravel mining and lakeshore housing development industries, slowing but not halting their expansion. Several sand and gravel mining companies modified their operations by opening new sandpits, relocating dredges, or moving slurry pipes, but no new waste sand nesting habitat was created for the birds to colonize. Several mine sites ceased production, which allowed the birds to nest at those locations without human interference. Construction at lakeshore housing developments continued, which eliminated nesting habitat at some locations, but added it at others. Rains and resulting high river flows and flooding in June 2010 overtopped most of the sandbars in the Lower Platte River. The tern and plover nests located on those overtopped sandbars were washed away. Approximately 72 hours after their nests were lost, these birds began re-nesting at off-river sites. Additional rains washed out many of these re-nesting attempts as well; some terns may have established 3 nests during the 2010 season.



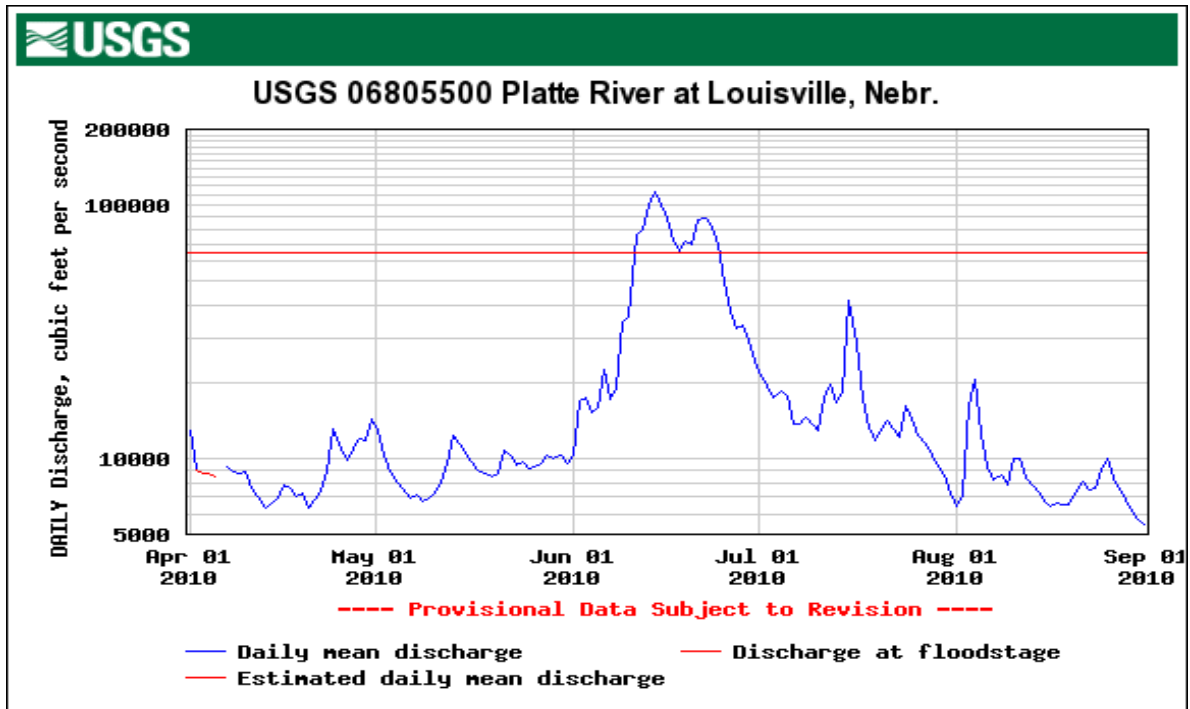


Figure 2. Daily water discharge (cubic feet per second; cfs) measured at the Louisville, Cass County, USGS gage from April through September 1, 2010.

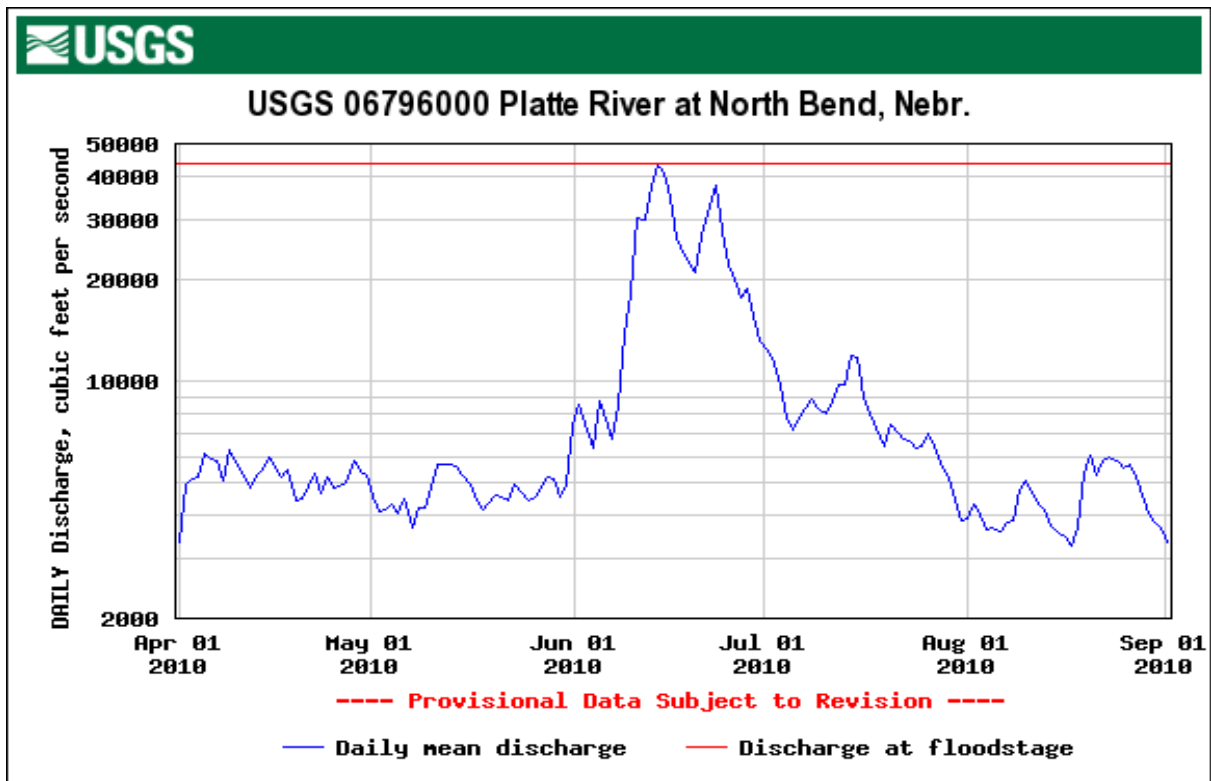


Figure 3. Daily water discharge (cubic feet per second; cfs) measured at the North Bend, Dodge County, USGS gage from April through September 1, 2010.

Monitoring

Regional Movements of Color-banded Piping Plovers

Breeding Range

We observed a number of previously-banded Piping Plovers in our Lower Platte River focus area in 2008, 2009 and 2010 (Figure 4). All of the plovers carrying light blue flags were originally banded along the Lower Platte River in 2008 or 2009; none originated from the United States Army Corps of Engineers (USACE) Missouri River captive rearing project (G. Pavelka, pers. comm.). All of the plovers carrying green flags were originally banded along the Gavin's Point Dam reach of the Missouri River between Sioux City, Dakota County, NE and Yankton, Yankton County, SD (G. Pavelka, D. Catlin and J. Felio, pers. comm.). The plover carrying a yellow flag was banded at Lake Sakakawea along the Missouri River in North Dakota.

Four Piping Plovers first banded by us in 2008 were seen in 2009 and 2010, two banded in 2008 were seen in 2009, two banded in 2008 were seen in 2010, and two banded in 2009 were seen in 2010.

Thirteen green-flagged plovers were seen at off-river sites along the Lower Platte River in 2010. Seven were observed near North Bend, two were observed near Genoa, three were observed near Ashland, and one was observed near Fremont.





Figure 4. Locations of Piping Plovers originally color-banded on the Gavin's Point Dam reach of the Missouri River (green box) and seen along the Lower Platte River in 2010. Dark green dots are locations where Piping Plovers were seen at off-river sites. The light green dot is the location where a plover was seen on a sandbar. The yellow dot marks the location where a bird originally banded at Lake Sakakawea in North Dakota was seen on a river sandbar in 2010.

Over-wintering Range

A number of Piping Plovers banded along the Lower Platte River in 2008, 2009, and 2010 have been seen along the United States Gulf Coast during the non-breeding season (Figure 5). They have been seen at Raccoon Island, Louisiana, North Pass and Redfish Bay, Texas, Mollie Beattie, Texas, Mustang Island, Texas, South Padre Island, Texas, Marcos Island (Naples) Florida, St. Joseph's State Park (Tallahassee), Florida, and Dauphin Island (Mobile), Alabama.

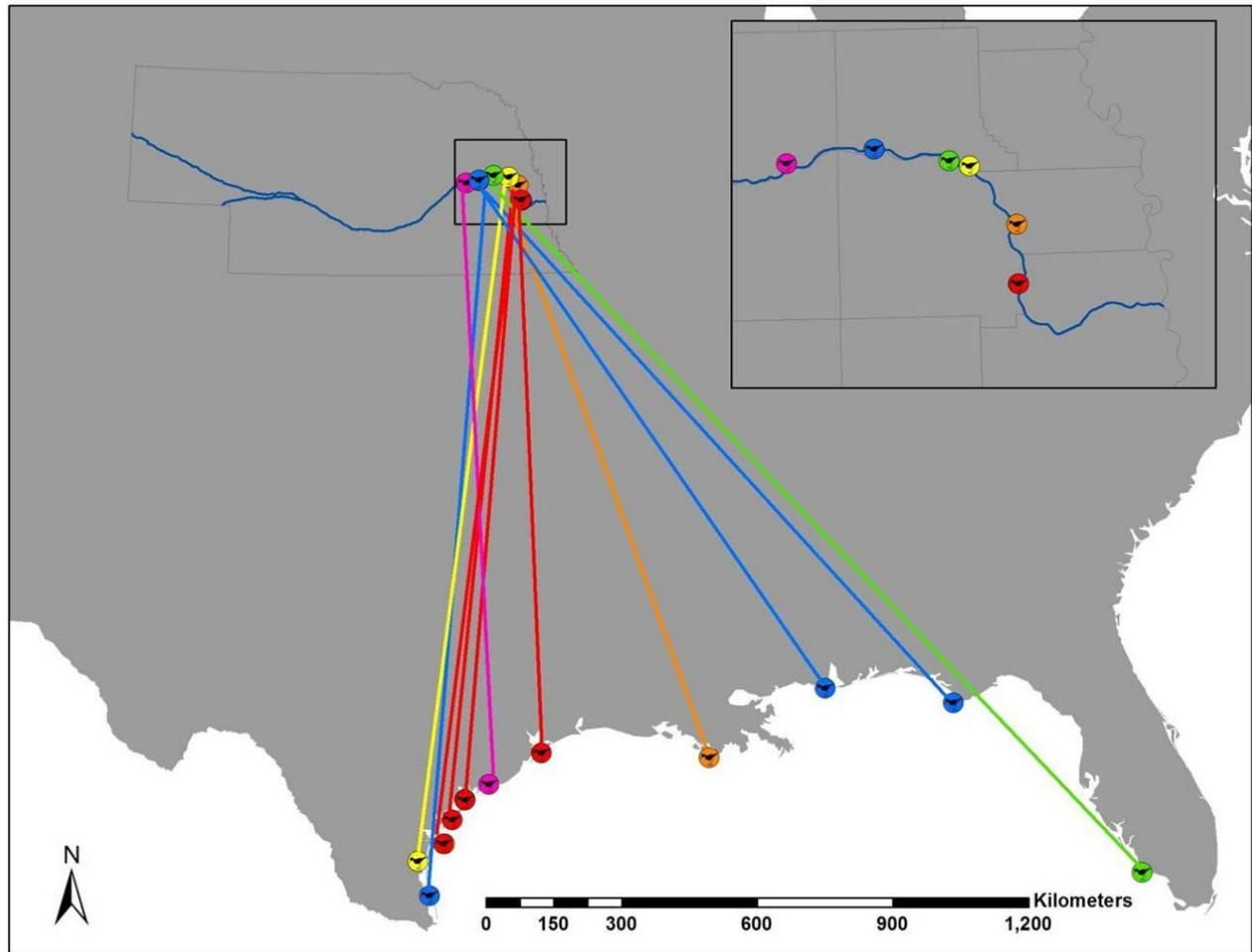


Figure 5. Locations of color-banded Piping Plovers seen during the non-breeding season on the United States Gulf Coast. Colors represent the nesting area where birds were banded.

Nest Monitoring

Methods – Off-river habitat

Beginning in mid-April, we began visiting all sand and gravel mines and lakeshore housing developments in the focus area. We concentrated our early-season attention on sites that supported nesting terns and plovers in the past. We did this because terns and plovers are philopatric and tend to return to areas where they nested successfully in the past. Each site was visited every 4 – 5 days and surveyed for birds. When birds were observed at a site, the open

sandy areas were searched for nests or evidence of nest scrapes. Most nests were located by observing adult birds sitting on nests. We recorded the location of every tern and plover nest that we found using a handheld GPS unit (Garmin Geko models 201 or 301), and each nest was assigned a unique number. We ‘floated’ the eggs in each nest to determine when they were laid (H. Hays and M. LeCroy 1972 Wilson Bulletin 83: 425 – 429); nearly all nests were located 1 – 6 days after the first egg was laid. Using these data, we calculated the eggs’ expected hatching date, assuming a 28-day incubation period for plovers and a 21-day incubation period for terns. We continued to locate nests throughout the season. All nests at off-river sites were visited every 4 – 5 days during the incubation period. These visits were to check for the presence of incubating adults and to count the number of eggs present; we did not repeat the “floating” procedure. We scored the status of each tern and plover nest based on the following criteria:

Confirmed successful: ‘pipped’ eggs or newly-hatched chick(s) observed in or in the immediate vicinity (< 1 meter) of the nest cup

Likely successful: empty but intact nest cup found with or without pieces of eggshell on or after the expected hatch date

Confirmed failure: nest cup and/or eggs found destroyed

Likely lost: nest not relocated on repeat visits prior to expected hatch date

At some off-river sites, terns and plovers placed their nests in areas that were not accessible to us for safety reasons. In these cases, we only recorded the number of nests, eggs, adults, chicks, juveniles, and fledglings that were visible from a safe distance.

On each regular visit to the sites, the total number of active nests and the total number of terns and plovers of each age class were recorded. The age classes we used were:

Adults: birds in full adult plumage

Chicks: 1 – 3 days, 4 – 10 days, 11 – 15 days

Juveniles: chicks older than 15 days, but still dependent on their parents

Fledglings: chicks capable of sustained flight and independent of their parents

If any adults or chicks were observed with leg bands, the color band combination was recorded. Any miscellaneous observations, including evidence of disturbance, vehicle tracks, weather conditions, or injuries were also recorded.

Results Off-River

Nesting Interior Least Terns and Piping Plovers were found at four areas along the Loup River and at twelve areas along the Lower Platte River (Figures 6–7). Of the 16 nesting areas we found on the two rivers, four were lakeshore housing developments and twelve were sand and gravel mines. See Table 1 for description and location information for these sites. All of these sites have been used for nesting in previous years. We are not aware of any previously unused off-river sites being colonized in 2010. See Appendix A for nest distribution maps.

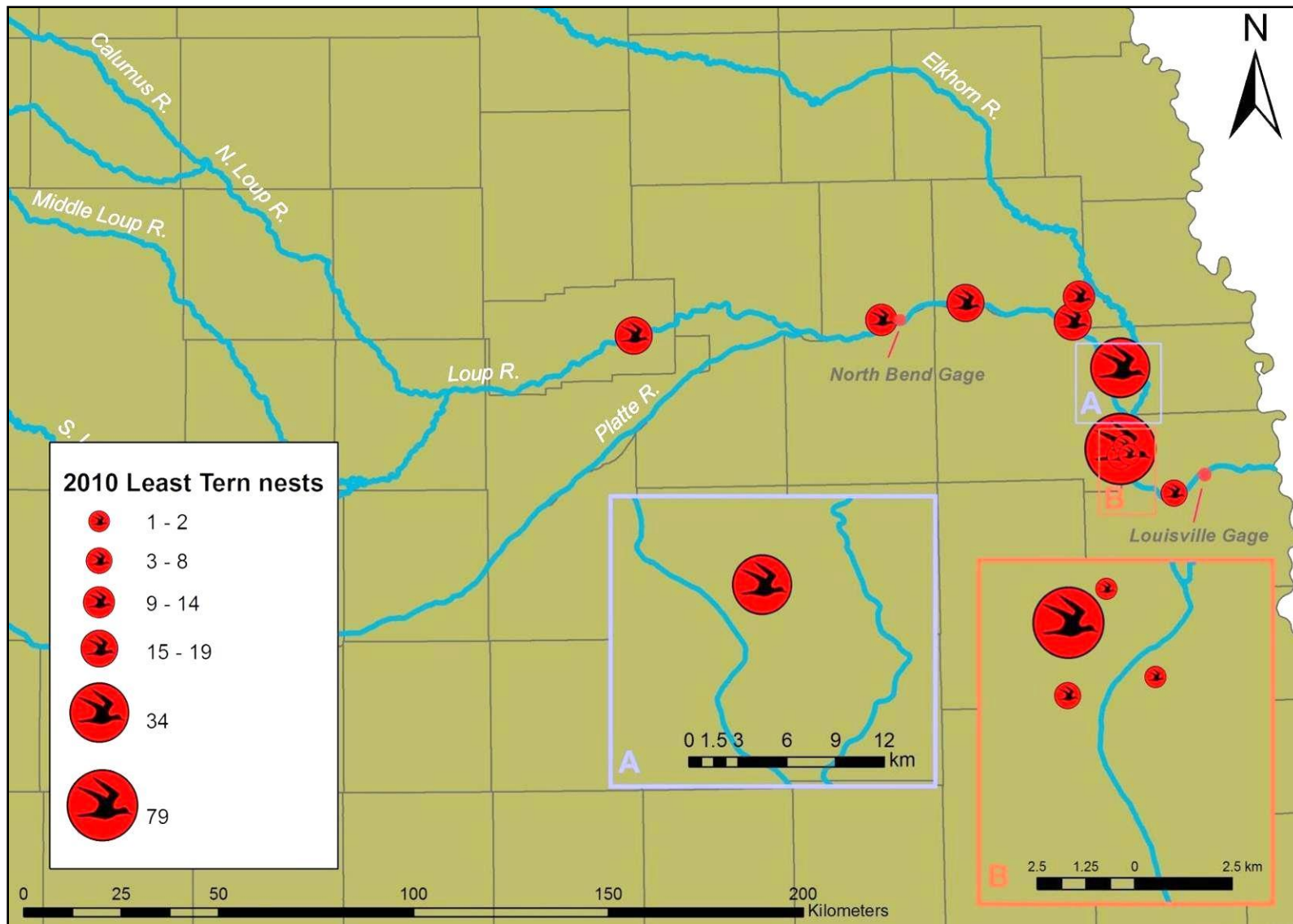


Figure 6. Location of **off-river** Interior Least Tern nesting sites.

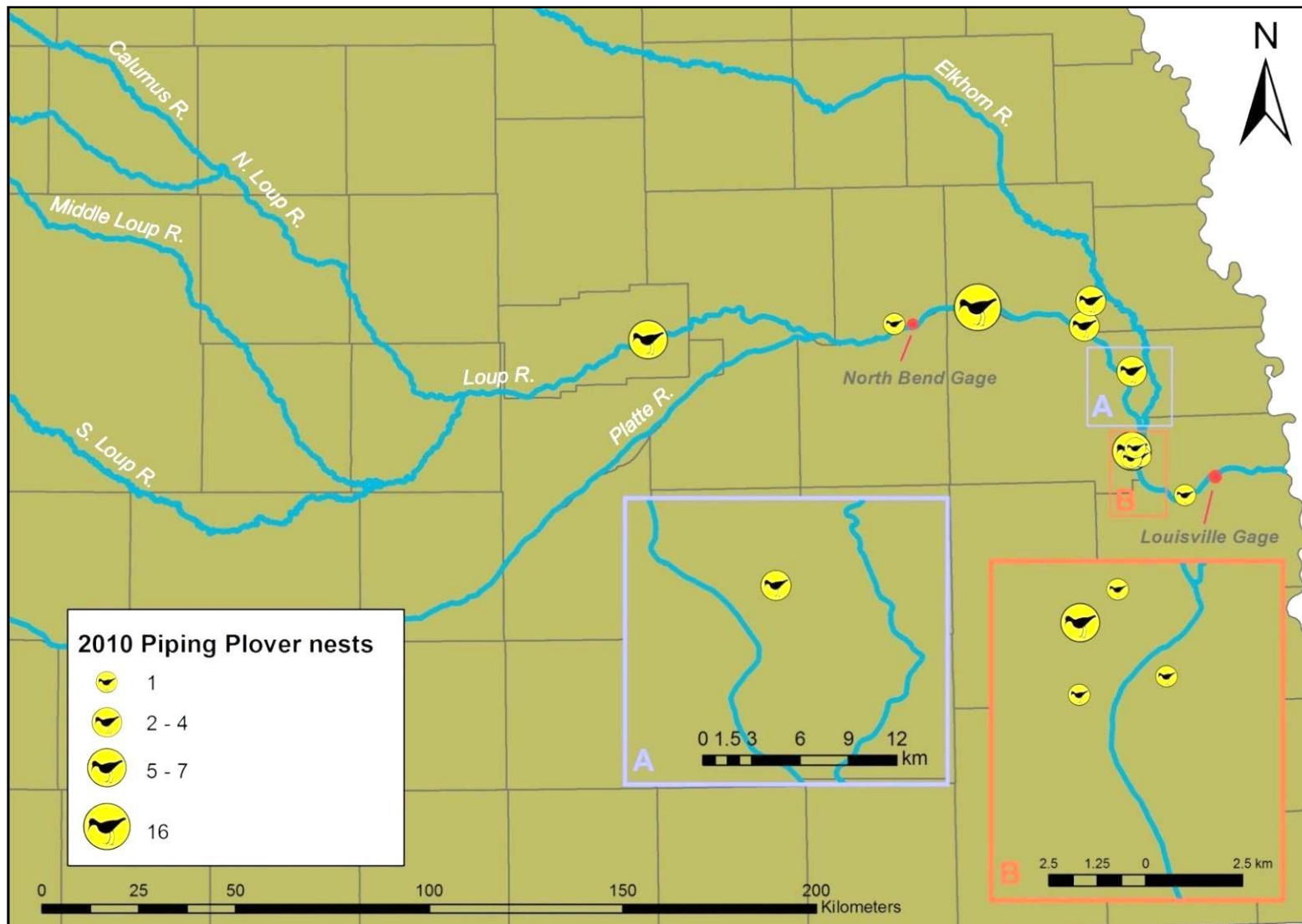


Figure 7. Location of **off-river** Piping Plover nesting sites.

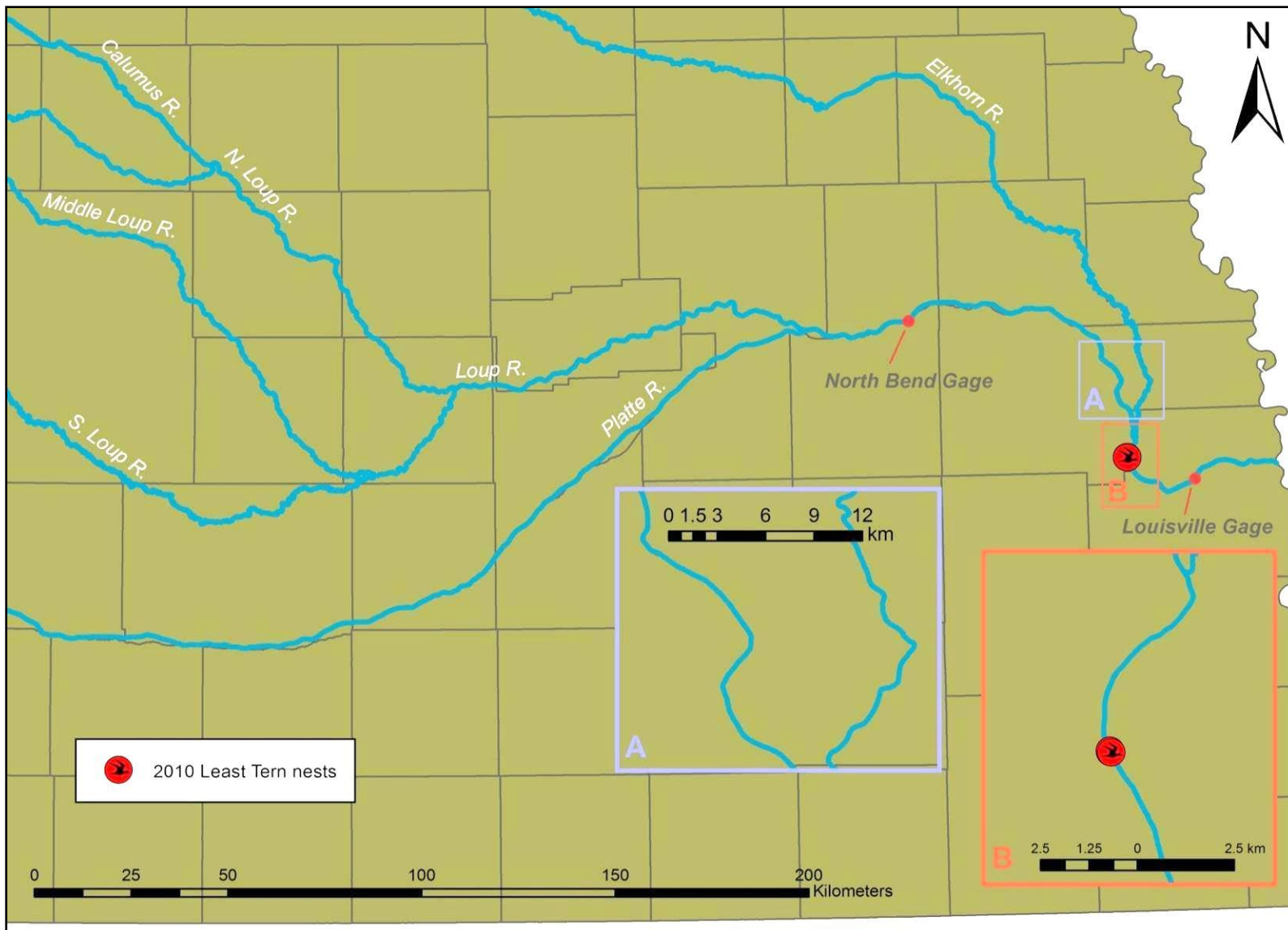


Figure 8. Location of **on-river** Interior Least Tern nesting sites **prior** to the June flooding.

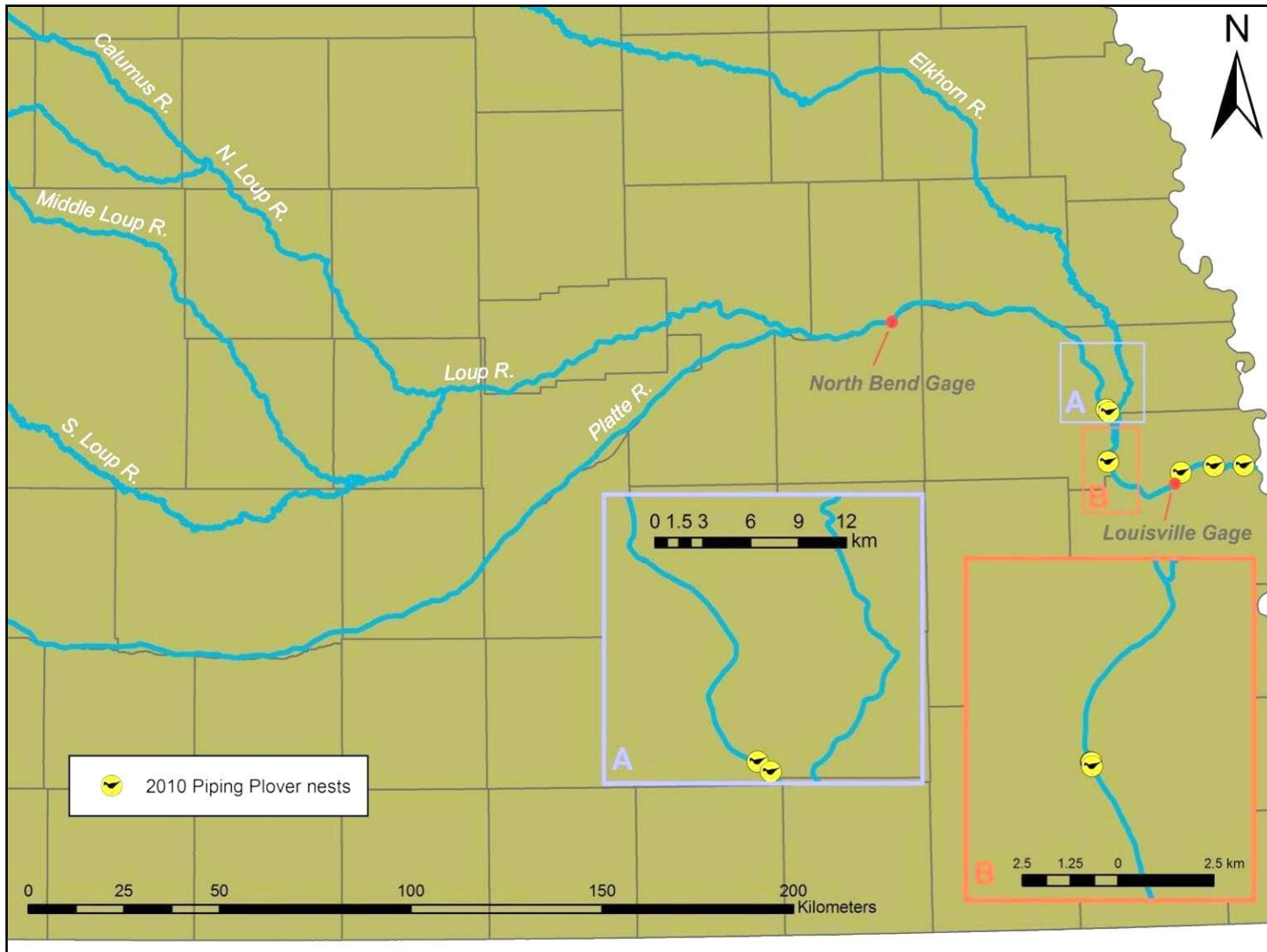


Figure 9. Location of **on-river** Piping Plover nesting sites **prior** to the June flooding.

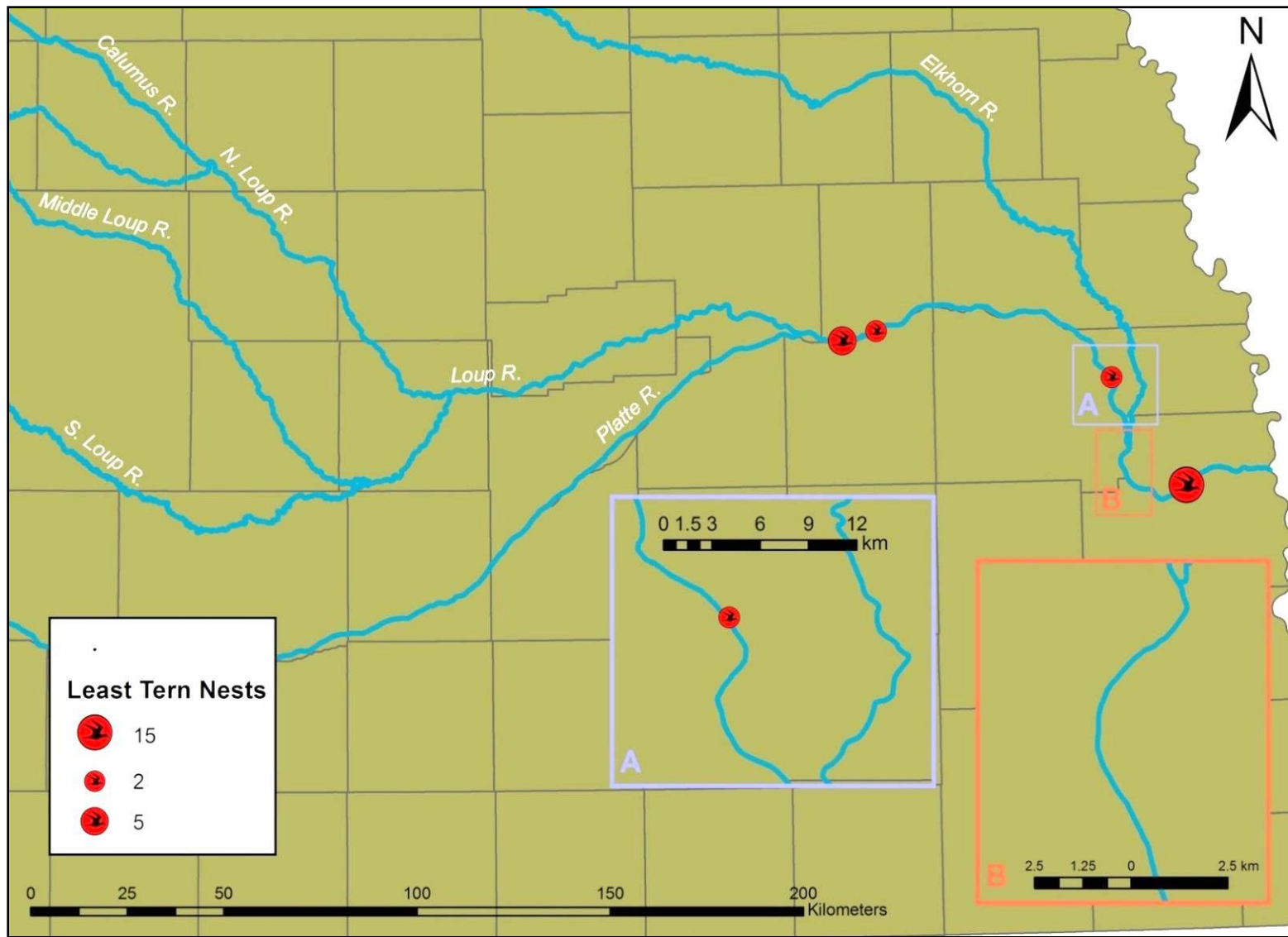


Figure 10. Location of **on-river** Interior Least Tern nesting sites **after** the June flooding (no plover nests were found at on-river sites after the June flooding).

PIPING PLOVER

OFF-RIVER SITE	TYPE	ADULTS	NESTS	NESTS LOST*	EGGS	EGGS LOST*	CHICKS	FLEDGING RATE**
Wilson Creek/Bellwood	Mine	3	0					
LPPD/Genoa	Mine	12	7	0	19	0	5	1
Mallard	Housing	8	2	0	9	0	6	3
Riverview Shores	Housing	37	16	0	48	0	29	2.4
Oreopolis/4 Mile Creek	Mine	4	1	1	4	4	0	0
Big Sandy	Housing	2	1	0	4	0	0	0
NE Fremont	Mine	6	2	0	5	0	3	1.5
Lake Socorro	Housing	2	1	0	4	0	2	2
Riverside	Mine	6	5	0	11	0	6	2
Melia	Mine	1	1	0			1	1
Louisville Lakes	Mine	2	1	1	4	4	0	0
Shady Lake Road	Mine	2	1	1	4	4	0	0
W Fremont	Mine	7	3	0	12	0	11	3.7
Thomas Lakes	Mine	5	1	0	4	0	3	3
TOTAL		97	42	3	128	12	66	1.57
Housing		49	20	0	65	0	37	1.85
Mines		48	22	3	63	12	29	1.32

* = eggs and nests lost to June rains and flooding

** = number of chicks per nest

INTERIOR LEAST TERN

OFF-RIVER SITE	TYPE	ADULTS	NESTS	NESTS LOST*	EGGS	EGGS LOST*	CHICKS	FLEDGING RATE**
Wilson Creek/Bellwood	Mine	0	0	0	0	0	0	0
LPPD/Genoa	Mine	22	19	9	50	22	4	0.21
Mallard	Housing	27	34	11	80	16	14	0.41
Riverview Shores	Housing	30	16	2	65	2	17	1.06
Oreopolis/4 Mile Creek	Mine	0	0	0	0	0	0	0
Big Sandy	Housing	3	2	1	6	3	1	0.5
NE Fremont	Mine	25	12	2	42	2	7	0.58
Lake Socorro	Housing	25	14	3	34	15	8	0.57
Riverside	Mine	37	79	47	143	94	32	0.41
Melia	Mine	2	1	1	1	1	0	0
Louisville Lakes	Mine	9	8	5	15	7	0	0
Shady Lake Road	Mine	4	2	2	4	4	0	0
W Fremont	Mine	24	17	10	55	16	12	0.71
Thomas Lakes	Mine	12	7	7	12	12	0	0
TOTAL								
Housing		220	211	100	507	194	95	0.45
Mines		85	66	17	185	36	40	0.61
		135	145	83	322	158	55	0.38

* = eggs and nests lost to June rains and flooding

** = number of chicks per nest

Piping Plovers began arriving in the focus area in April. The first off-river sighting was near Ashland on 19 April 2010, when one bird was seen. Terns began arriving in the focus area in May. The first off-river sighting was of one bird near Fremont on 7 May 2010.

Based on egg 'floating' data, the first off-river plover egg was laid on 4 May 2010 near Ashland, and the last was laid on 17 June 2010 near Ashland. The first off-river tern egg was laid on 24 May 2010 near Fremont and the last was laid on 12 July 2010 near Ashland.

The first off-river plover egg hatched on 31 May 2010 near Ashland and the last hatched on 27 July 2010 near Ashland. The first off-river tern egg hatched on 22 June 2010 near North Bend and the last hatched on 2 August 2010 near Ashland.

The last sighting of both off-river plovers and off-river terns was on 2 August 2010 near Ashland.

Methods – On-river habitat

Because access to on-river nesting sites differs from off-river sites, we took a different approach to monitoring terns and plovers nesting on midstream river sandbars. We began monitoring river conditions for the presence of sandbar habitat early in the nesting season. Once river flows and water depth decreased (exposing sandbars), we began regularly surveying the river by canoe and kayak for the presence of terns and plovers. Canoe and kayak surveys provide the advantage of moving slowly (< 10 kph) and quietly on the river, which limits the amount of disturbance to nesting terns and plovers. The presence of birds foraging in the river indicated that birds might be nesting on a nearby sandbar. When a colony was located, the sandbar was thoroughly surveyed for nests. Once nests were found, we used the same nest monitoring method as for off-river nests. Nest locations were recorded with a handheld GPS unit (Garmin Geko models 201 or 301), the number of eggs was recorded, and the eggs were 'floated' to determine the nest initiation date (H. Hays and M. LeCroy. 1971. *Wilson Bulletin* 83:425 – 429). Nesting colonies were visited every 2 – 7 days. These visits were to check for the presence of incubating adults and to count the number of eggs present; we did not repeat the "floating" procedure. We scored the status of each tern and plover nest based on the following criteria:

Confirmed successful: 'pipped' eggs or newly-hatched chick(s) observed in or in the immediate vicinity (< 1 meter) of the nest cup

Likely successful: empty but intact nest cup found with or without pieces of eggshell on or after the expected hatch date

Confirmed failure: nest cup and/or eggs found destroyed

Likely lost: nest not relocated on repeated visits prior to expected hatch date

Results – On-river

High water conditions during June impacted bird use and productivity on the river. High water limited our ability to survey the river in June and July, but because of the flooding no nesting habitat was available. River surveys, performed prior to the June flooding, covered only river miles (RMs) 0 – 40. These surveys located eight Piping Plover nests and five Least Tern nests (Figures 8–10). None of these nests survived the flooding. All Least Tern nests were located on the South Camp Ashland Sandbar.

After the high water receded, the entire Lower Platte River was surveyed between 8 and 30 July. During this period, we located four Least Tern colonies including one on the Cedar Creek sandbar complex, where several chicks were observed. Colonies at RMs 45, 90, and 96 likely did not fledge any young. The colonies at RM 90 and 96 were visited a second time on 6 August. The colony at RM 96 appeared abandoned. Eggs in one of the two nests at RM 90 were newly hatched, but since it was so late in the nesting season it seems unlikely that young would have fledged from this nesting attempt. No follow-up visits were conducted.



Research

Estimating Survival Rates

Accurately estimating demographic parameters, such as daily and seasonal survival probabilities for individual birds and nests, helps us better understand local and regional population dynamics of Interior Least Terns and Piping Plovers. This will allow us to develop effective management strategies for these two species. In 2010, we continued to improve our estimates of nest, adult, and chick survival by using capture-mark-recapture and statistical modeling techniques (Program MARK). We also constructed growth curves for tern and plover chicks.

Methods

We conducted all bird capture and banding under the authorization of the USGS Bird Banding Laboratory (Patuxent Wildlife Research Center, <http://www.pwrc.usgs.gov/bbl>) and the U.S. Fish and Wildlife Service through an inter-agency agreement with the Nebraska Game and Parks Commission (MBB holds Federal Master Bird Bander Permit # 23545, with Threatened and Endangered Species endorsements and Nebraska Educational and Scientific Permit # 905; the TPCP holds Federal Threatened and Endangered Species handling permit #TE 070027-1; JGJ holds Federal Master Bird Bander Permit #20259, with Threatened and Endangered Species endorsements). Color-band combinations were coordinated prior to the field season with the Bird Banding Laboratory and others with an interest in tern and plover research.

We captured, banded, and color marked adult Piping Plovers during incubation at off-river sites (Figures 11-12). Out of concern for the birds' safety, we used a simple box trap placed over the nest for capture (Figure 11). Box traps have no moving parts, so the nesting birds and their eggs are not injured during capture; the bird walks through the door, settles on its nest, and is captured.



Figure 11. Wire box trap placed over a Piping Plover nest showing the bird approaching the trap (A), entering through the open “door” (B), and settling on the nest (C). Time elapsed is less than one minute.

Our capture, handling, and banding protocols were the same as those used in 2008 and 2009. We exercised caution when handling and banding birds. We did not capture or band birds during extreme weather (cold, windy, rainy, or when inclement weather was forecast) or when the temperature was above 85° F (30° C). Birds were observed after banding and on subsequent visits to determine if there were any behavioral changes or signs of injury. As part of our protocol, we were to suspend all banding activities if problems or injuries were observed

at any time. We did not observe any problems or injuries to birds as a result of monitoring, capture, handling, or banding in 2008, 2009 or 2010.

Each plover received an individually-numbered metal USGS band (size 1A) on one upper leg (Figure 12). On the opposite upper leg, each bird received a light blue flag; the light blue color indicates that the bird was banded along the Platte River. The Lower Platte River blue flags are 'half length' and not crimped when placed on the bird's leg. On one lower leg, each bird received a unique combination of two different color bands (black, gray, green, red, or yellow) indicating its individual identity. On the opposite lower leg, each bird received two color bands in one of three combinations (green over green, red over red or yellow over red); these color combinations indicate that the bird was banded at an off-river site in 2010. Birds banded at off-river sites received a single color band (green) on the lower leg in 2008 and two color bands (red over green, red over yellow or red over red) in 2009. See Appendix B for a complete listing of all color band combinations used in 2008, 2009, and 2010.

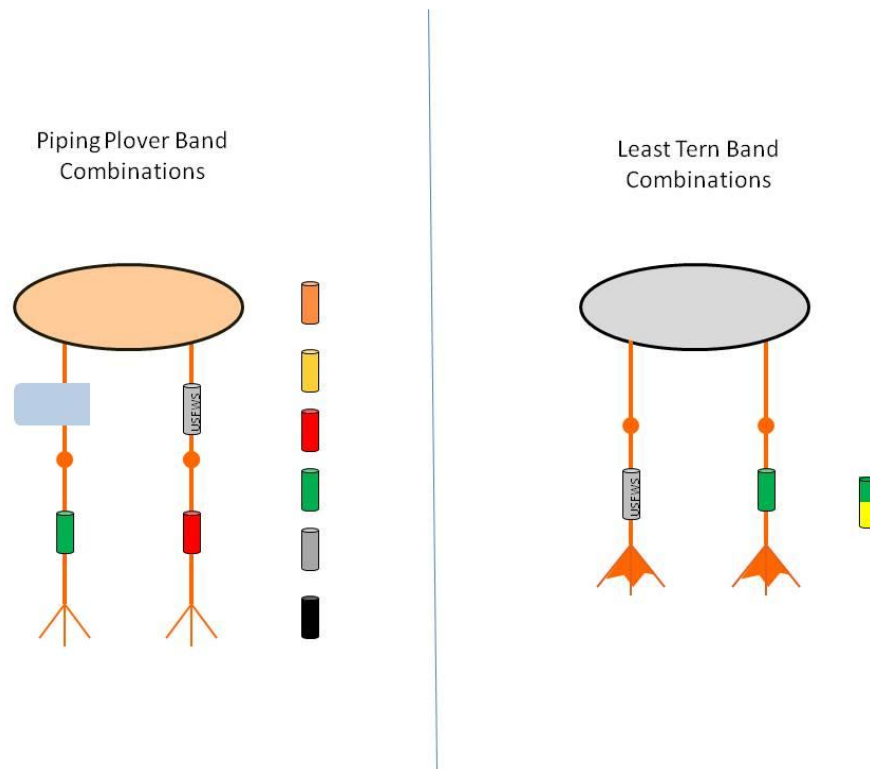


Figure 12. Diagram illustrating the color banding scheme used with Piping Plovers and Interior Least Terns on the lower Platte River. The flags, color bands, and metal bands may be on either leg.

After banding, we measured the mass of each plover by placing the bird in a cloth bag and suspending it from a Pesola™ scale ($\pm 0.3\%$ accuracy). We took the following morphological measurements for every adult plover we captured: length of the left and right flattened wing chord (wrist to the distal end of the outermost primary feather), length of the left, right, and middle tail feathers, length of the left and right tarsus (unfeathered leg above the hallux), length of the culmen (exposed midline ridge of the beak), width of the beak at the nostrils, and length of the total skull (distal end of the beak to the posterior end of the skull). All measurements were taken by one individual (MBB) to minimize measurement error. Each measurement was taken

twice so a “repeatability index” could be calculated. We calculated a composite metric of all measurements (the geometric mean) to provide an index of each bird’s overall size. The left and right sides of each bird were measured so a measure of bilateral symmetry could be calculated. Symmetry is a commonly used measure of an individual bird’s “quality.” The symmetry of skeletal parts and feathers reflects an individual’s nutrition and health during development; this gives us a metric to assess the “quality” of birds produced at different nesting habitats (on-river versus off-river) and in different years. Symmetry also gives us a way to assess the quality of over-wintering habitat for birds; better foraging habitat provides better over-wintering survival, nutrition and health for nesting birds.

We captured Piping Plover chicks at off-river sites by picking them up from the sand or from their nests. Plover chicks’ legs are long enough that we were able to color band them using the same protocol as we did with adult plovers. See Appendix B for a complete listing of all color band combinations used in 2008, 2009, and 2010. We measured each chick’s body mass by placing chicks on a digital scale (Ohaus® SP401) that was accurate to ± 0.1 gram. Scales were calibrated using a standardized weight to ensure accuracy. We did not take any morphological measurements of plover chicks.

We captured Interior Least Tern chicks at off-river sites by picking them up from the sand or from their nests. We did not attempt to capture adult Interior Least Terns. Tern chicks’ legs are very short, so we only put an individually-numbered USGS band (size 1A) on each bird’s lower leg and a split-color (yellow-green) band on the opposite lower leg. The yellow-green split color band indicates that the bird was banded at an off-river site along the Lower Platte River. We did not take any morphological measurements of tern chicks.

Survival analyses: After banding individual Piping Plover adults and chicks and Interior Least Tern chicks, we attempted to re-sight them as frequently as possible. Upon re-sighting we noted where they were seen, which birds they were seen with, and what they were doing. We used this capture-mark-recapture dataset to calculate daily and seasonal survival probabilities for each individual. After individual tern and plover nests were located, we monitored them throughout the nesting season (see Monitoring section for details). We used information from this monitoring dataset to calculate daily and seasonal nest survival probabilities.

We estimated survival probabilities using the software program MARK (G.C. White and K.P. Burnham 1999. *Bird Study* 46: S120 – S139). We used the general methods of J.-D. Lebreton et al (*Ecological Monographs* 1992. 62: 67 – 118), K. P. Burnham and D. R. Anderson (2002. *Model Selection and Multimodel Inference: a Practical Information-Theoretic Approach* 2nd edition, New York: Springer), and S.J. Dinsmore and J.J. Dinsmore (*Studies in Avian Biology* 2007. 34: 73 – 83). Model fit for each analysis was assessed by the AIC (Akaike’s Information Criterion); the model with the lowest AIC was considered the model that best fit the data.

Individual Survival Analysis

Individual encounter histories were constructed for all Piping Plover adults and chicks that were captured, recaptured or observed at off-river sites throughout the nesting season. All adult plovers included in this analysis were color-banded along the Lower Platte River (light blue leg flags) or along the Missouri River (green leg flags). All plover and tern chicks included in this analysis were produced and banded along the Lower Platte River.

We did not include any covariates in the models. We tried to fit models with varying degrees of time-dependence to the data, but the model that included constant survival and constant recapture probabilities $\{\phi(c), p(c)\}$ was always the best-fitting model based on AIC; this is most likely due to our small sample sizes.

Nest Survival Analysis

We used data from nest monitoring (see Monitoring and Management sections) to analyze nest survival. Nest survival probabilities were calculated using the nest-survival utility in Program MARK. We constructed encounter histories by summarizing the day each nest was found (k), the last day the nest was found active (l), the last day the nest was checked for activity (m), and the fate of the nest (f). Due to small sample sizes we did not include any covariates in our model and assumed constant survival across the season.

Growth Curve Analysis

Our growth curve analysis included only Interior Least Tern and Piping Plover chicks that were produced at off-river sites. All tern and plover chicks were banded and weighed when they were first encountered. They were re-weighed every time they were subsequently encountered. In cases where the chick was banded while still in or very close to the nest, we could 'age' them based on the nest's known hatching date. If chicks were banded after they left the nest, we estimated their age from an age-based time series of photographs.

Sand Sampling

To help us describe nest site characteristics of Piping Plovers and Interior Least Terns, we collected sand samples from 30 plover and 63 tern nests in 2010. The samples included one 6-inch long, 2-inch wide core taken through the nest cup and four 4-inch diameter, 1-inch deep cores taken around the nest cup (oriented N, S, E, and W). The cores were analyzed by sifting the material through a standardized series of sieves (numbers 18, 35, 60, 140, and 325) to sort the material by particle size; the material was then weighed. All samples were collected after the eggs had hatched and the chicks moved away from the nest, or when it was certain that the eggs were not going to hatch (i.e., well beyond the 21- and 28-day incubation periods).

Statistical Analysis

All statistical analyses were performed using either SAS (SAS Institute. 2004. SAS/STAT User's Guide, Version 9.1. SAS Institute, Cary, NC) or Prism (GraphPad Prism, Version 3.00 for Windows, Graph Pad Software, San Diego, CA). Due to small sample sizes, we used nonparametric statistical tests; statistical significance was set at $P < 0.05$. Means (± 1 SE) are reported.

Results

Banding and Resightings

We captured and banded nine adult Piping Plovers and 49 plover chicks at off-river nesting sites. We re-sighted 25 plovers that we had banded along the Lower Platte River in 2008 and 2009 and 13 adult plovers that were banded along the Missouri River (green flags).

We captured and banded 120 Interior Least Tern chicks at off-river nesting sites. Most tern chicks were less than two weeks old when banded. One adult Interior Least Tern with a yellow-green split band was seen attending a nest at Riverview Shores, near North Bend, Dodge County on 29 June 2010. This bird was banded as a chick in 2008.

Daily and Seasonal Survival

Piping Plover Nest Survival: We based our calculation of Piping Plover nest survival on a population of 41 nests located at off-river sites (19 at lakeshore housing developments and 22 at sand and gravel mines). Off-river nests in 2010 had an apparent daily survival probability of 0.9885 ± 0.0041 . When those daily survival probabilities are extended over the 28-day incubation period, off-river plover nests in 2010 had an apparent survival probability of 0.7229 ± 0.0870 (Figure 13).

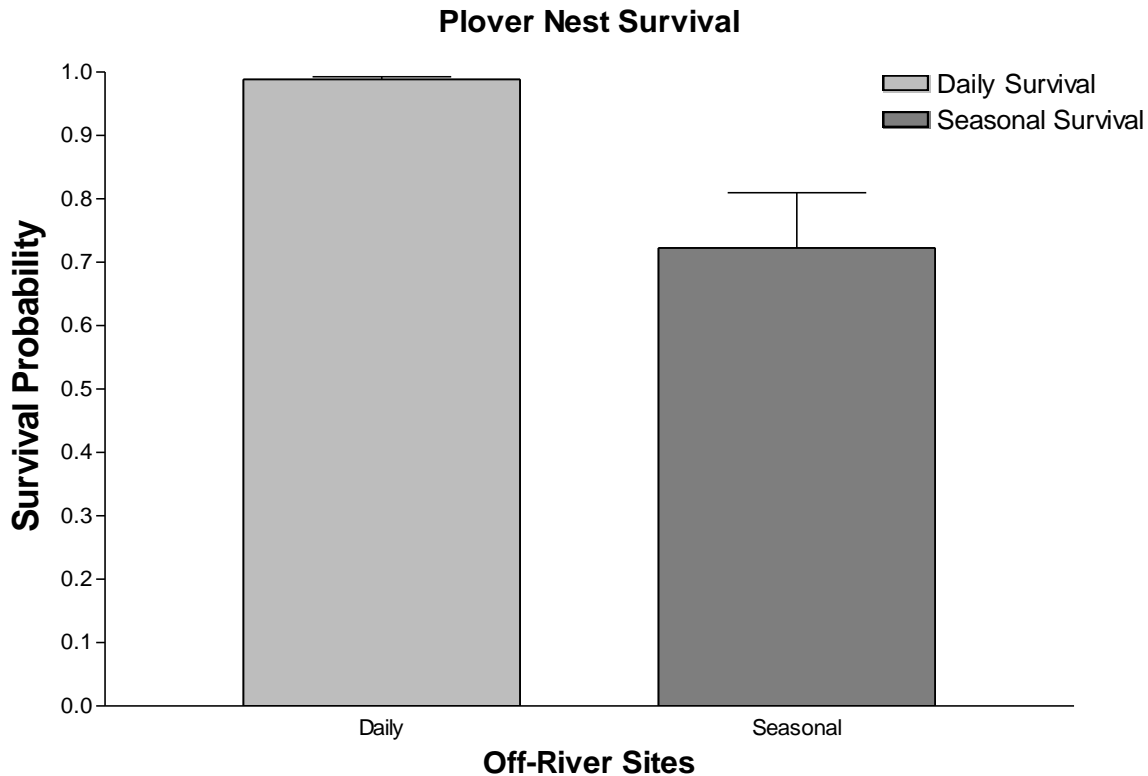


Figure 13. Off-river Piping Plover apparent daily nest survival probability and 28-day incubation survival probability.

Piping Plover Individual Survival: Based on our population of color-marked adult Piping Plovers, the apparent daily survival probability for birds nesting at lakeshore housing development sites in 2010 was 0.9807 ± 0.0067 (see Figure 14). When that daily survival probability is extended over the 28-day incubation period, adult plovers had an apparent survival probability of 0.5790 ± 0.0412 . Based on a similar calculation, the apparent probability of adult plovers at lakeshore housing developments surviving the 28-day brood rearing period was also 0.5790 ± 0.0412 . The apparent daily recapture probability for adult plovers at lakeshore housing developments was 0.1753 ± 0.0258 .

The apparent daily survival probability for adult plovers nesting at sand and gravel mine sites was 0.9910 ± 0.0077 (see Figure 14). When that daily survival probability is extended over the 28-day incubation period, adult plovers at sand and gravel mine sites had an apparent survival probability of 0.7764 ± 0.0511 . Based on a similar calculation, the apparent probability of adult plovers at sand and gravel mine sites surviving the 28-day brood rearing period was also 0.7764 ± 0.0511 . The apparent daily recapture probability for adult plovers at sand and gravel mines was 0.1197 ± 0.0315 .

Based on our population of color-marked Piping Plover chicks, the apparent daily survival probability for birds reared at lakeshore housing development sites in 2010 was 0.9767 ± 0.0140 (see Figure 14). When that daily survival probability is extended over the 28-day fledging period, plover chicks had an apparent survival probability of 0.5166 ± 0.0853 . The apparent daily recapture probability for plover chicks at lakeshore housing developments in 2010 was 0.1626 ± 0.0462 . The apparent daily survival probability for plover chicks reared at sand and gravel mine sites in 2010 was 0.8612 ± 0.0574 (see Figure 14). When that daily survival probability is extended over the 28-day fledging period, plover chicks at sand and gravel mine sites in 2010 had an apparent survival probability of 0.0152 ± 0.1638 . The apparent daily recapture probability for plover chicks at sand and gravel mines was 0.3403 ± 0.1781 .

These survival and recapture estimates are likely biased and the standard error values large due to small sample sizes and the inability of Program MARK to distinguish between mortality and permanent emigration; hence we refer to them as apparent. We expect to refine these estimates in the future as our population of banded individuals increases.



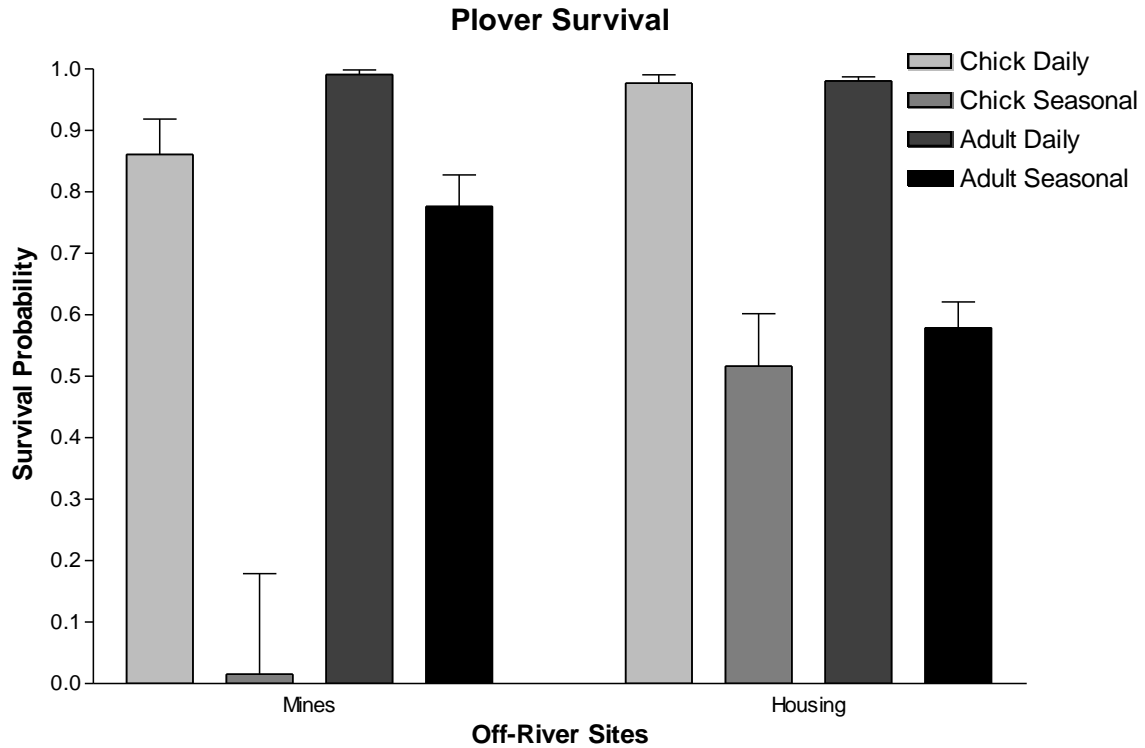


Figure 14. Piping Plover (adult and chick) apparent daily and seasonal survival probabilities.

Piping Plover Chick Growth Curve: We based the calculation of our Piping Plover chick growth curve on our population of banded plover chicks produced at off-river sites. The regression line that best fits our 2010 data shows that plover chicks grew at a fairly constant rate until fledging, in contrast to 2008 and 2009 when they grew rapidly for the first two weeks of life and then less rapidly until they fledged.



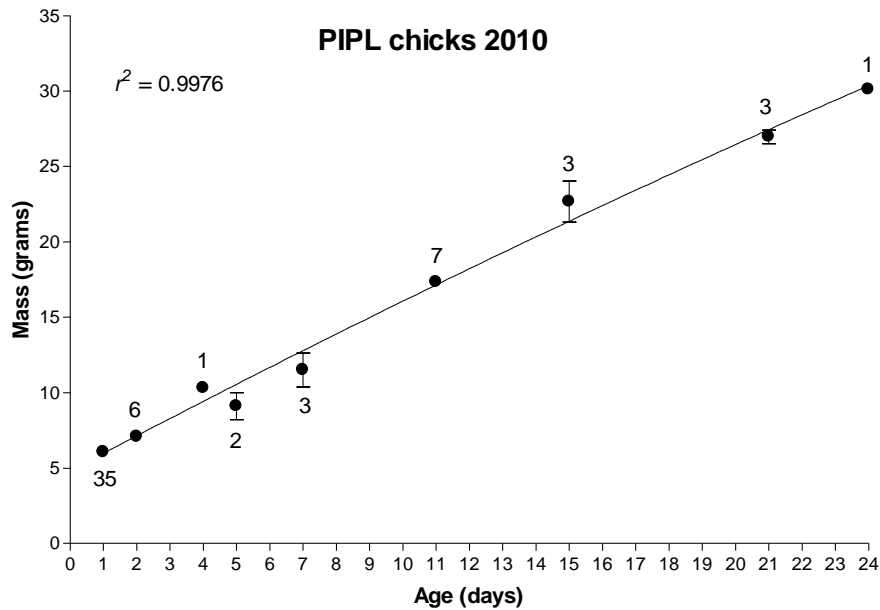


Figure 15. Growth rate of Piping Plover chicks from off-river sites. The graph shows the data represented as mean mass, standard error and sample size (number of individuals weighed at each age).

Interior Least Tern Nest Survival: We based our calculation of Interior Least Tern nest survival on a population of 247 nests from off-river sites. We estimate that tern nests at lakeshore housing developments in 2010 had an apparent daily survival probability of 0.9847 ± 0.0036 (Figure 16). When the daily survival probability is extended over the 21-day incubation period, tern nests had an apparent incubation period survival probability of 0.7241 ± 0.0686 . We estimate that tern nests at sand and gravel mines had an apparent daily survival probability of 0.9686 ± 0.0036 . When the daily survival probability is extended over the 21-day incubation period, tern nests at sand and gravel mines had an apparent incubation period survival probability of 0.5120 ± 0.0434 .



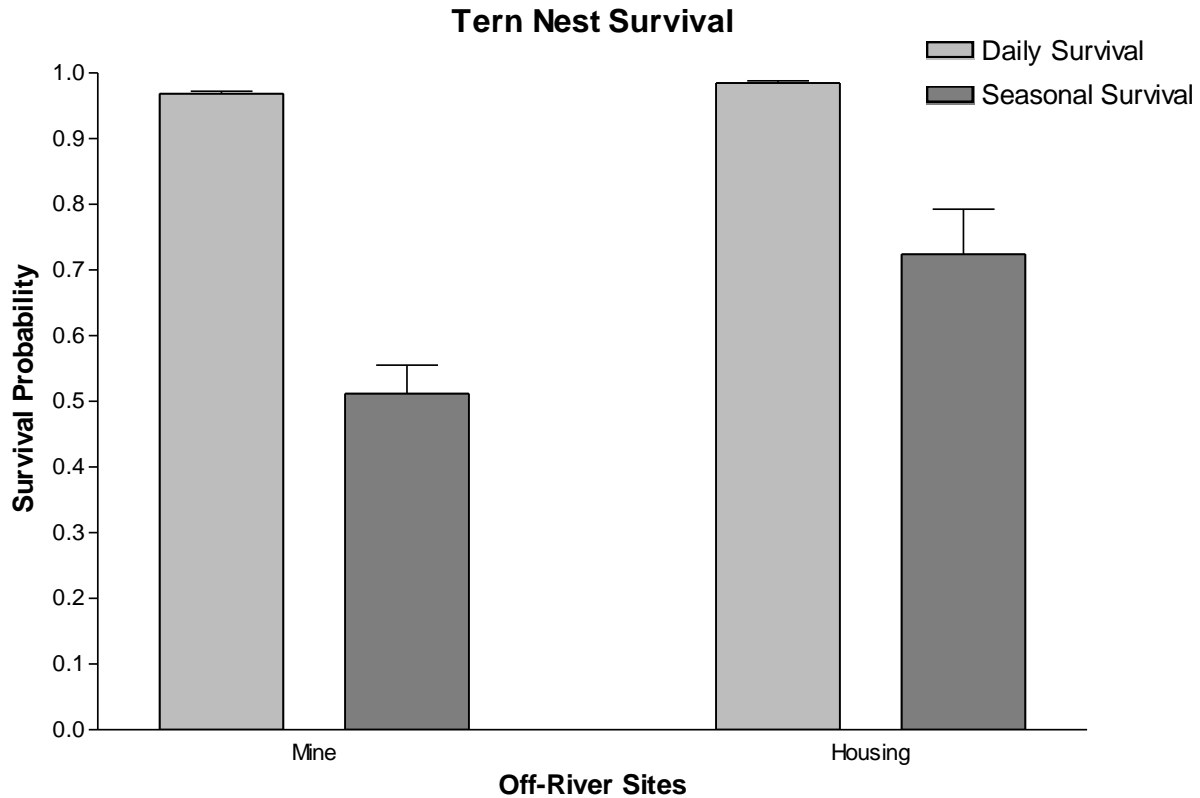


Figure 16. Interior Least Tern apparent daily nest survival and 21-day incubation period survival.

Interior Least Tern Chick Survival: Based on our population of color-marked Interior Least Tern chicks, the apparent daily survival probability for birds reared at lakeshore housing development sites in 2010 was 0.9464 ± 0.0601 (Figure 17). When that daily survival probability is extended over the 21-day fledging period, tern chicks at lakeshore housing development sites in 2010 had an apparent survival probability of 0.3149 ± 0.3026 . The apparent daily recapture probability for tern chicks at lakeshore housing developments in 2010 was 0.0425 ± 0.0297 . The apparent daily survival probability for tern chicks reared at sand and gravel mine sites in 2010 was 0.9293 ± 0.0747 (Figure 17). When that daily survival probability is extended over the 21-day fledging period, tern chicks at sand and gravel mine sites had an apparent survival probability of 0.2143 ± 0.3369 . The apparent daily recapture probability for tern chicks at sand and gravel mines was 0.0328 ± 0.0287 .

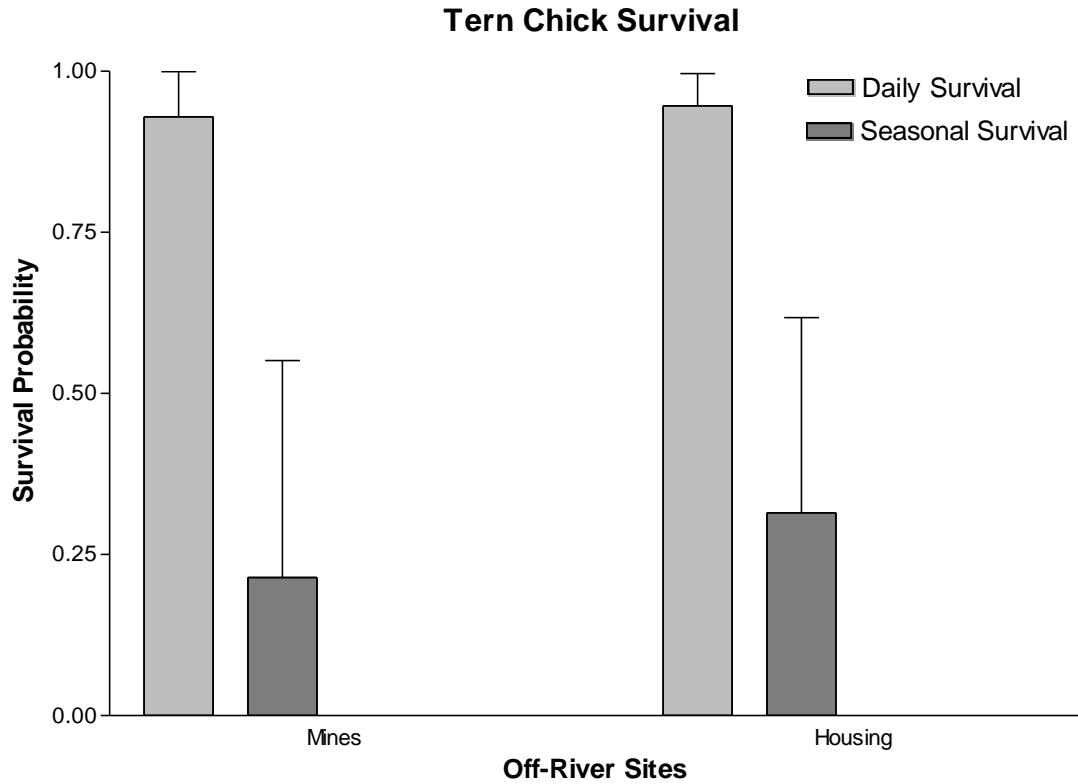


Figure 17. Interior Least Tern chick apparent daily survival probability and probability of survival to fledging.

Interior Least Tern Chick Growth Curve: We based the calculation of our Interior Least Tern chick growth curve on our population of banded tern chicks produced at off-river sites. The regression line that best fits our 2010 data shows that tern chicks grew at a fairly constant rate until fledging, in contrast to 2008 and 2009 when they grew rapidly for the first two weeks of life and then less rapidly until they fledged (Figure 18).



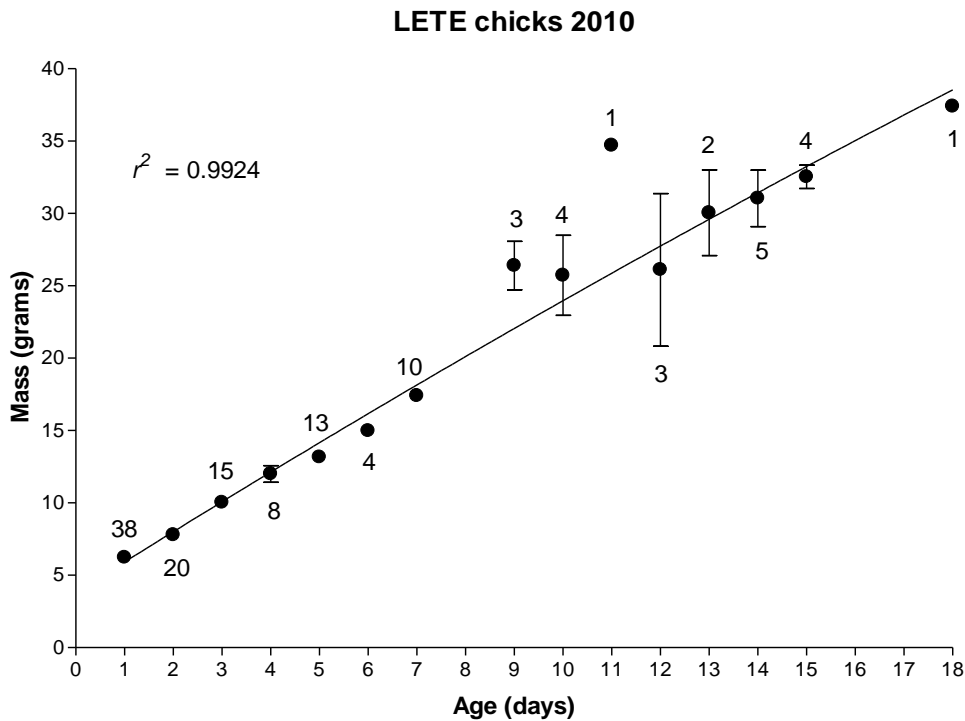


Figure 18. Growth curve of Interior Least Terns chicks from off-river sites. The graph shows the data represented as mean mass, standard error and sample size (number of individuals weighed at each age).

Off-river Interior Least Tern and Piping Plover nesting success

The traditional index of nesting success for terns and plovers that is reported and used for comparison between sites is a 'fledge ratio'. Fledge ratio is calculated as the number of fledglings per adult pair over a defined spatial or temporal area. As a matter of practicality, this is usually calculated as the number of fledglings per nest. The number of fledglings used in the calculation is based on the number of birds directly observed. Unless these birds are individually marked, errors are introduced into the calculation.

Using the 'fledglings per nest' method, we found that the Piping Plover fledge ratio was 1.57 chicks per nest (1.85 at housing developments and 1.32 at sand and gravel mines) and the Interior Least Tern fledge ratio was 0.45 chicks per nest (0.61 at housing developments and 0.38 at sand and gravel mines).

Assessing On-River Nesting Habitat

In 2010, as in 2008 and 2009, we assessed sandbar nesting habitat available to Least Terns and Piping Plovers. Unfortunately, the June flooding prevented us from completing a thorough assessment of the sandbars. Nonetheless, here we report some initial observations from the past three years of field work. We focus on macro-form sandbars created by the 2008 high flow event (see Brown and Jorgensen 2008) and used as breeding sites by terns and plovers in 2008, 2009, and 2010, and how these sandbars persisted over time.

It is known that “high flows” are necessary to scour existing sandbars of vegetation and create new sandbars (Sidle et al. 1992; Parham 2007; Nebraska Game and Parks Commission 2007; Elliot et al. 2009). However, specific flow regimes or events that generate sandbars used for nesting are poorly understood. Studies have not identified which river flow regimes create new sandbars and scour existing sandbars, how sandbars created by a specific flow regime persist over time and for how long a sandbar provides nesting habitat. We use events from 2007–2010 to address two questions: 1) did a high flow event create new sandbars or scour and reconfigure existing sandbars later used as nesting sites?, and 2) how long do sandbars used as nesting sites persist?

Methods

We analyzed data from two sections of the LPR, between RMs 0–13 and between RM 20–40. In the following analyses, we used publicly available data and field data we collected during the 2008, 2009 and 2010 seasons. The public data include gage data from USGS gaging stations and aerial photographs taken in 2007 and 2009 (digital orthophoto quadrangles) from the Nebraska Department of Natural Resources spatial/GIS database (<http://www.dnr.ne.gov/databank/spat.html>). Field data include nest locations, nesting sandbar areas and nesting sandbar elevations. Field work in 2010 was ended by the June flooding event, so our 2010 data are incomplete.

Nest Location Data

The focus area was surveyed for Interior Least Tern and Piping Plover nests by airboat (2007) or canoe and kayak (2008–2010). See Monitoring section for details.

Sandbar Surface Area

At nesting sites, surface areas were calculated by walking the perimeter of the sandbar with a handheld GPS unit (Garmin Geko model 201 or 301) and marking waypoints at approximately 10 meter intervals. In cases where the perimeter of the sandbar was irregular, more waypoints were recorded so a more accurate area could be calculated. Waypoints were downloaded and imported in ArcMap (ESRI Inc 2006, Version 9.2, Redlands, CA). A shape file was created in ArcCatalog and imported into ArcMap. The GPS unit, waypoint file, and ArcMap were set to the same projection (North American Datum 1983, UTM Zone 14). We verified specific sandbar locations using aerial photographs.

Sandbar Elevation

The elevation of each sandbar was measured using an automatic level (CST Berget® PAL/SAL “N” Series) and stadia. All automatic level measurements were taken by one person (JGJ) to

minimize measurement error. We limited the amount of time we spent in and around nesting colonies to minimize disturbance to nesting birds. Transects were run perpendicularly to the river channel, beginning and ending at the waterline. The automatic level was set up at the mid-point of each transect line and measurements were taken at 2–20 m intervals along the length of the transect line. Measurement locations were recorded with a handheld GPS unit. To measure the highest elevation of the sandbar, several measurements were taken in the portion of the sandbar that we estimated had the highest elevation. Typically terns and plovers select the highest portion of the sandbar for nesting, so we also took elevation measurements in the areas where nests were located. We did not attempt to provide a complete topographic description of the sandbar. All of the sandbars had ‘table top’ topography, and by taking multiple measurements of the table top area, we captured a representative description of the sandbar. Sandbar heights were calculated by subtracting the waterline measurements from the sandbar height measurements. All height measurements were recorded in feet and are reported in that unit to be consistent with gage station measurements.

Sandbar elevations and surface areas are dependent on the river flow at the time the measurements are taken (the waterline varies with river flow). We used river flow measurements from gage stations to establish a reference level for our sandbar height measurements (<http://waterdata.usgs.gov/ne/nwis/rt>). The sandbars located below the Salt Creek confluence were referenced to the Louisville gage. The sandbars above the Salt Creek confluence and below the Elkhorn River confluence were referenced to the Ashland gage. The sandbars above the Elkhorn River confluence were referenced to the Leshara gage. The sandbars above Fremont were referenced to the North Bend gage. See Figure 19 for reference gage locations for the four different river reaches. We identified the highest and lowest river flow measurements (cfs) at the reference gage station within the 24-hour period that each sandbar was measured. These measurements provided the upper and lower limits of water elevation (waterline) on the day the sandbar was measured. This allowed us to quantify the range of values within which the actual sandbar height fell.

We used nest locations, aerial photographs, and sandbar perimeters to determine if nesting sandbars used in 2008 were present in the river in 2007 and if nesting sandbars were in the same locations in 2009 and 2010. We used sandbar elevation and gage data to determine whether a high flow event between breeding seasons may have created sandbars in different locations.



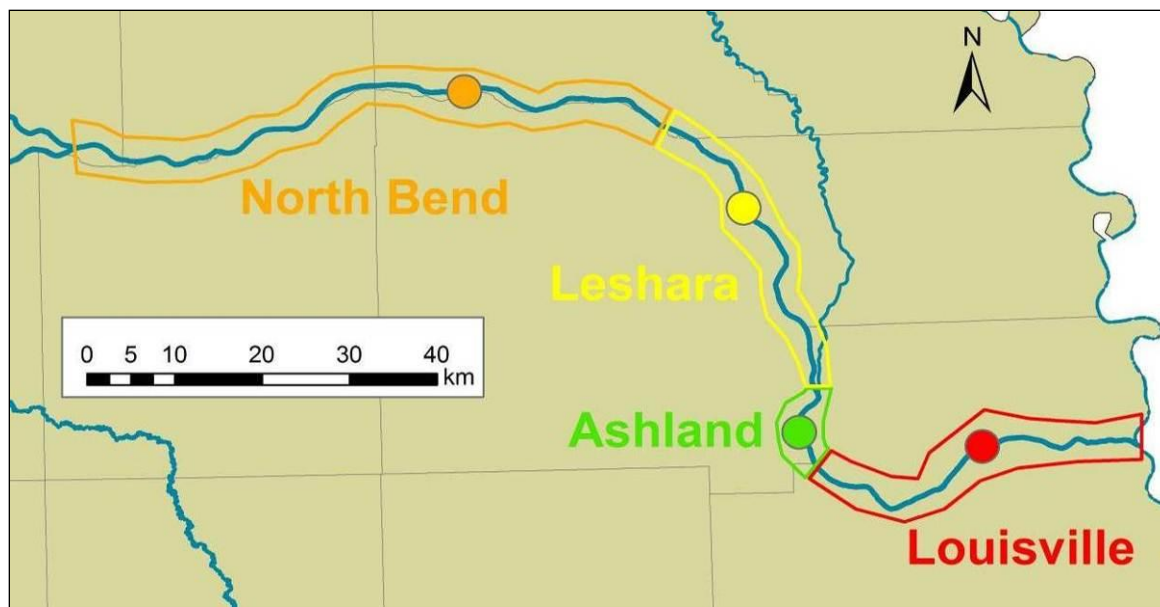


Figure 19. River reaches (colored boxes) and reference gage station locations (colored dots) used to reference sandbar elevation data.

RESULTS

We identified 13 sandbars that were used as nesting sites in 2008 (Table 1). Review of 2007 aerial photographs showed that 12 of these sandbars were not present during the 2007 breeding season. The exception was the Cullom sandbar (RM 7; Figure 21). During the 2009 breeding season, sandbars used for nesting were found at 11 of the 13 sandbar locations recorded in 2008. During surveys completed before the June flooding in 2010, sandbars were found at 11 of 13 sandbar locations recorded in 2009. Nesting was observed at 5 of the 11 sandbars. Figure 20 shows the South Camp Ashland sandbar that was used by nesting birds during the three consecutive seasons. Our sandbar elevation and gage data show that no high flow event between June 2008 and June 2010 was of sufficient magnitude to create the macro-form sandbars observed and that were used as nesting sites in 2008, 2009, and early 2010, suggesting that the sandbars were remnants of the June 2008 high flow/flooding event (Figure 22).

Table 2. Macro-form sandbars in RM stretches 0–13 and 20–40. Symbols for each year indicate sandbar not present (0), sandbar present but no nests located (/), sandbar present with nests located (X). CFS – Min and CFS – Max represent threshold flow values required to overtop sandbars. Minimum and maximum are provided because of uncertainty of field measurements when they are related to river gage stations.

River Mile	2008	2009	2010	CFS – Min	CFS - Max
7.0	X	X	X	71,500	80,500
9.0	X	X	/	48,000	55,000
12.3	X	X	/		
12.8	X	X	X		
12.9	X	X	0	53,500	62,000
22.0	X	X	/	35,700	40,800
24.4	X	X	0	19,700	30,400
24.5	X	X	0	15,700	25,100
28.5	X	X	/	25,100	37,800
29.1	X	X	X	17,600	27,600
35.0	X	0	0		
37.0	X	0	0		
38.8	X	X	X	25,100	35,100



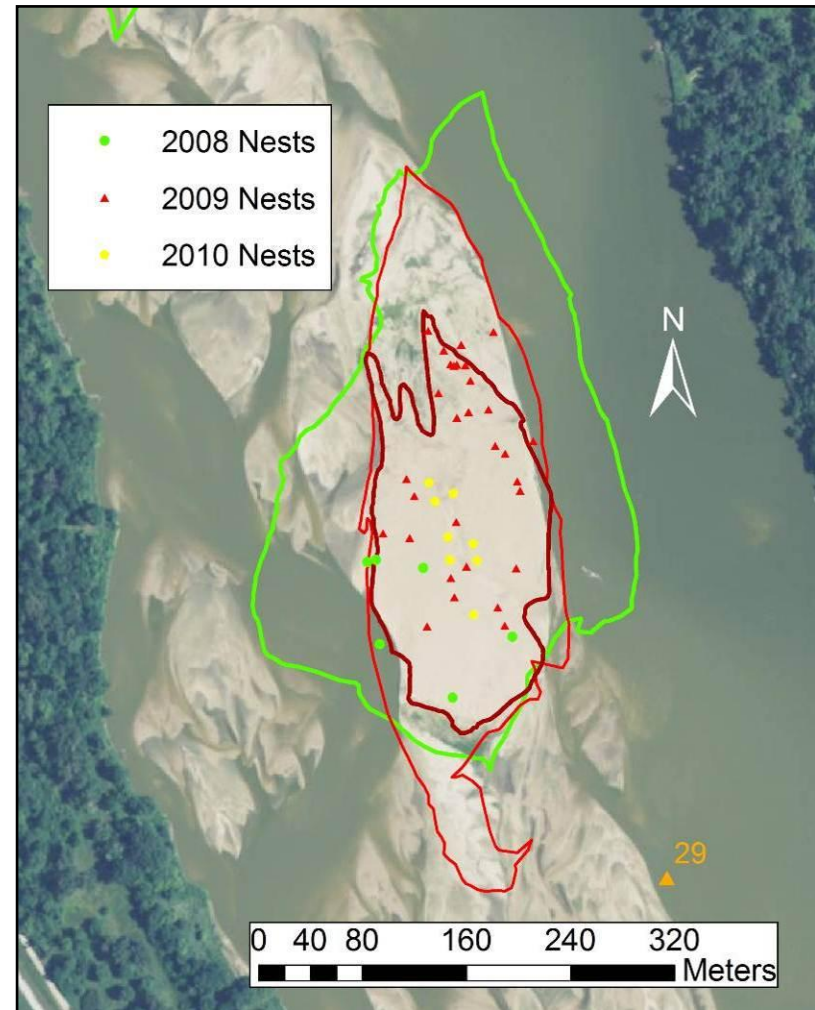
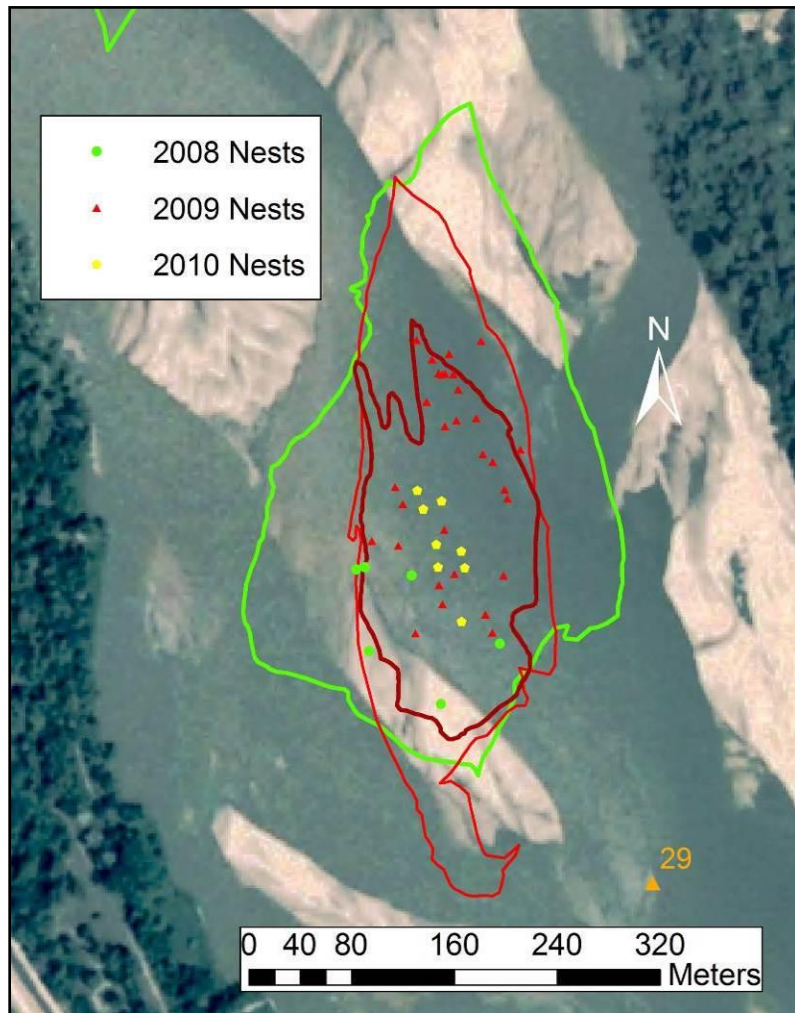


Figure 20. 2007 (left) and 2009 (right) aerial photographs with 2008 (green) and 2009 (red, extent of inundation is dark red) sandbar perimeters, and 2008, 2009, and 2010 Interior Least Tern and Piping Plover nest locations.

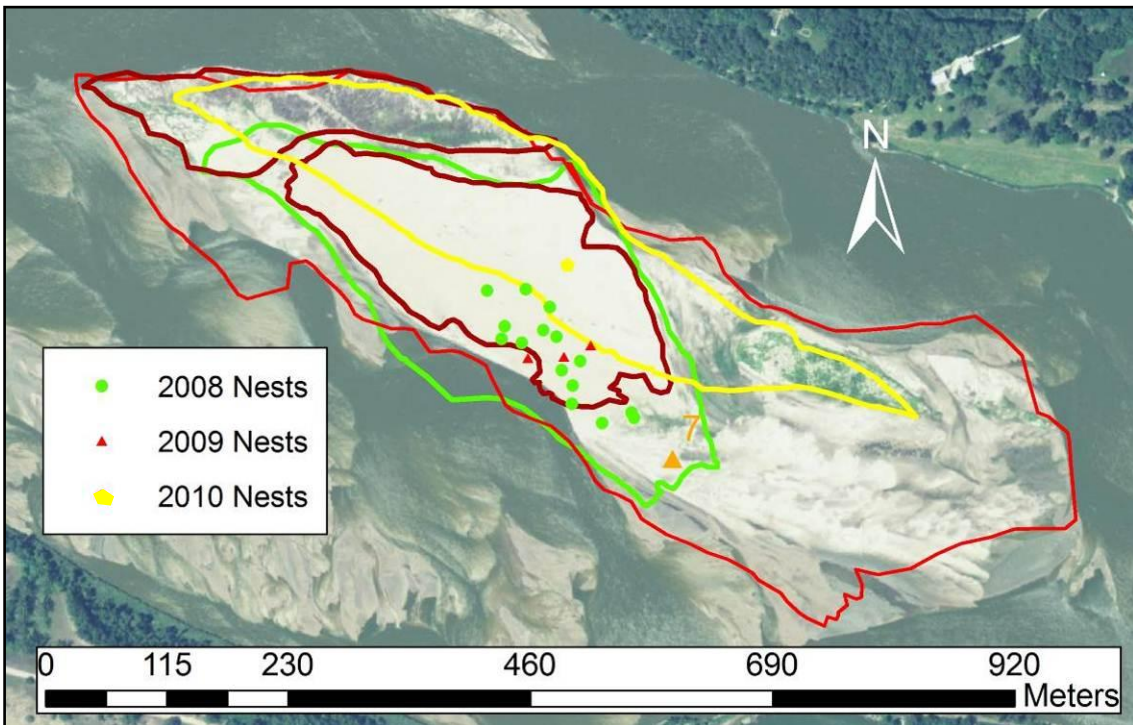
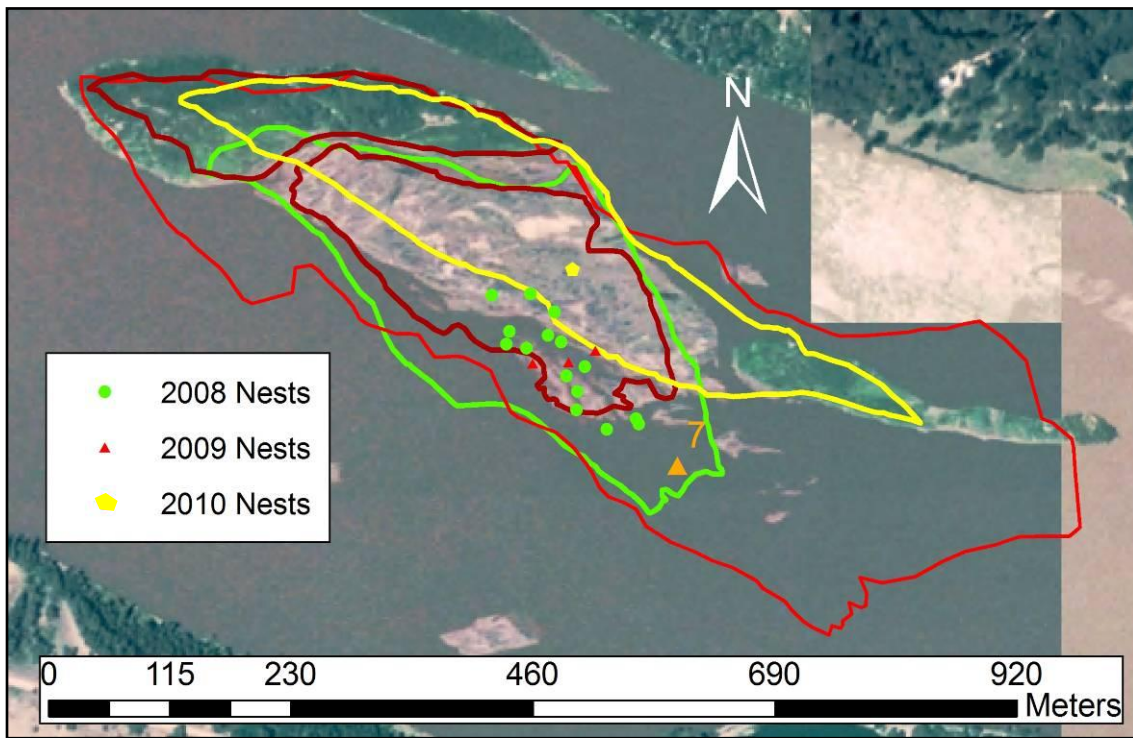


Figure 21. 2007 (above) and 2009 (below) aerial photographs with 2008 (green), 2009 (red, extent of inundation is dark red), and 2010 (yellow) sandbar perimeters, and 2008, 2009, and 2010 Interior Least Tern and Piping Plover nest locations.

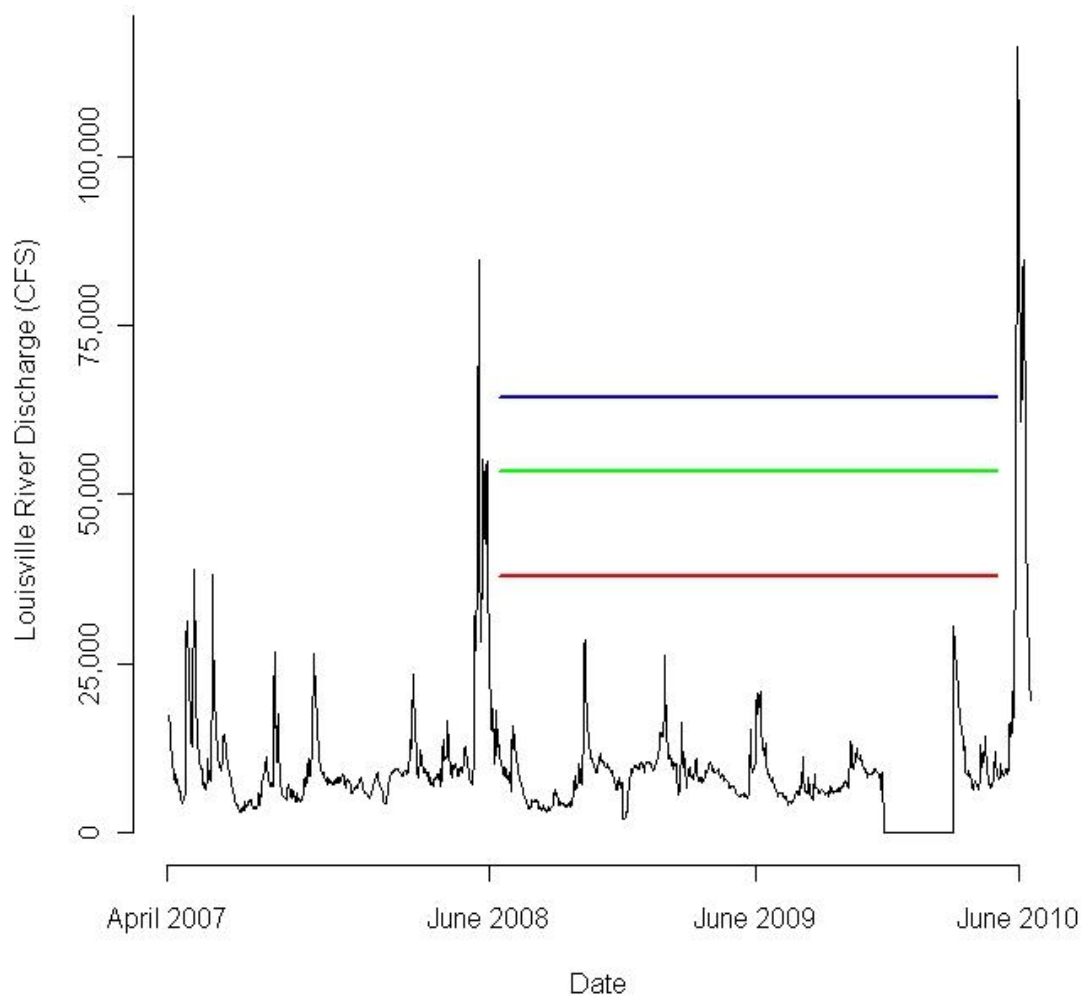


Figure 22. Louisville hydrograph, April 2007 through June 2010. Colored horizontal lines are lower thresholds of nesting sandbars (West Cedar Creek, Gun Club, Cullom). Flows during intervening periods between 2008 and 2010 high flow events do not reach or exceed sandbar thresholds, indicating those sandbars were created or renovated during the 2008 high flow event and persisted until the 2010 flood event.

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Identification of Fish Captured by Interior Least Terns

We collected the dead fish we found on the sand near tern nests; we assume that these represented a sample of what adult terns were feeding their chicks. Most of the fish were larval gizzard shad (1 inch or less in length, *Dorosoma cepedianum*). Largemouth bass (2 inches or less in length, *Micropterus salmoides*), red shiner (2 inches or less in length, *Cyprinella lutrensis*), emerald shiner (2 inches or less in length, *Notropis atherinoides*), and sunfish (2 inches or less in length, Family Centrarchidae) were also found. Based on body size, larval gizzard shad are likely fed to very young chicks, with larger fish added as the chicks grow in size. Courting male terns often 'present' female terns with male red shiner (silver with red fins). Fish identifications were made by Dustin Martin (UNL SNR).



Management

The Tern and Plover Conservation Partnership uses a voluntary, proactive approach to avoid human-bird conflicts and to eliminate the need for law enforcement actions in tern and plover management. There were no conflicts or need for law enforcement in 2010, as was the case in 2008 and 2009.

Before terns and plovers returned to Nebraska and the field season began, TPCP met with the production and land managers of all area sand and gravel mines. We discussed the mining companies' production plans for the season, safety regulations, and site access. We paid particular attention to concerns mine personnel had regarding previous on-site activities of the TPCP and changes to MSHA (Mine Safety and Health Administration) policy as it applies to non-mine personnel. We also met with homeowners' associations at the lakeshore housing developments. At these meetings, we discussed the construction plans for the area and site access. We paid particular attention to property owners' concerns regarding previous on-site activities of the TPCP.

The result of each these meetings was a set of site-specific management and monitoring plans; an equally valuable result was becoming acquainted with the people living and working at these sites. This made our management efforts easier to implement as the season progressed. We maintained close contact with these individuals throughout the season, so we could respond to any on-site changes that developed.

Protecting Interior Least Tern and Piping Plover Nests

In order to protect tern and plover nests, we put up "Keep Out" signs around the perimeter of all off-river nesting areas; these signs were designed in 2008 by the TPCP and are being adopted for use across Nebraska. In areas where considerable human foot or vehicle traffic was expected, additional 'psychological' barriers were added. These barriers consisted of black cord tied between all of the "Keep Out" sign posts; we tied red-silver Mylar™ streamers to the cord to make it more visible.



Based on conversations with mine production managers and homeowners' associations before the nesting season began, we mapped out the areas where it would be best if the terns and plovers did not nest. These were areas within the mine property that were going to be dredged during the nesting season or where heavy equipment was going to be operating. At the housing

developments, these were areas where buildings were to be constructed or utilities were to be installed. We know that terns and plovers prefer not to nest in areas where the substrate is disturbed by raking, where there is any surface vegetation, where the substrate particle size is “wrong” or where there is any physical disturbance (J. Marcus, J. Dinan, R. Johnson, E. Blakenship, and J. Lackey 2007. *Waterbirds* 30: 251 – 258). Planting vegetation, resurfacing the sand, and raking the substrate are labor intensive, so we opted for the physical disturbance method of discouraging birds from nesting in an area. In areas where we did not want the birds to nest, we put up grids of three-foot-tall poles with 16-foot-long streamers of red-silver Mylar™ flagging attached to them. The poles are set 16 feet apart. When the streamers blow in the wind, they make a crackling sound and sweep the ground, which discourages the birds from attempting to nest in the area.



We placed protective wire mesh nest enclosures around 31 off-river plover nests; the remaining 10 nests did not have enclosures. We did not put enclosures around tern nests, as they will not accept any structures around their nests.



Preferred Rocks of Genoa-Loup Public Power District Bird Management Area

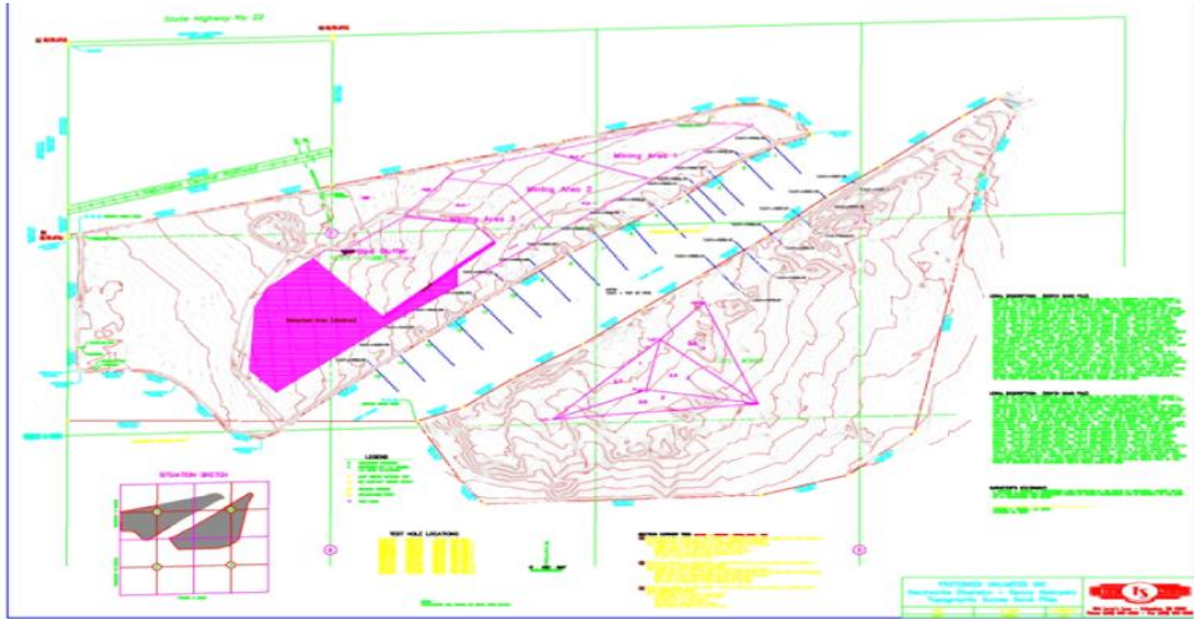


Figure 21. Schematic diagram of the “North Sand Management Zone” found at the LPPD Headworks – Preferred Rocks of Genoa facility.

In March 2008, the United States Fish and Wildlife Service, Nebraska Game and Parks Commission, and Preferred Rocks of Genoa entered into a Memorandum of Understanding (MOU) outlining the management of the Interior Least Terns and Piping Plovers nesting on the North Sand Management Zone (NSMZ). The TPCP and Loup Public Power District (LPPD) are cooperators, not signatories, to the MOU. The NSMZ is adjacent to the LPPD’s Loup Diversion and settling basin near Genoa, Nance County, NE. Sand is dredged from the settling basin and pumped onto the NSMZ. The slurry water from the dredging operation flows across the NSMZ from the northeast to the southwest, resembling a miniature river complete with small fish and sandbars. As part of their standard operating policy, LPPD stops dredging the settling basin when the birds arrive and begin nesting; dredging resumes after the birds depart. We are not aware of any nests being washed away by slurry water. With the assistance of Preferred Rocks of Genoa employees Kenton Zimmer, Maintenance Supervisor, Richard Plumtree, Production Supervisor, and Gary Pearson, LPPD Headworks Supervisor, TPCP monitored the birds nesting at the NSMZ.

Loup Public Power District-FERC (Federal Energy Regulatory Commission) relicensing project. In 2009, Loup Public Power District, which operates the North Sand Management Zone near the Loup Diversion and settling basin near Genoa, Nance County, NE (see above) initiated the process of renewing their 25-year license to operate hydropower-generating facilities near Monroe and Columbus, Platte County, NE. The TPCP cooperates with FERC, LPPD, HDR Engineering, United States Fish and Wildlife Service, Nebraska Game and Parks Commission, United States National Parks Service, and others on this relicensing project. Our role is to serve as threatened and endangered species experts, in general, and Interior Least Tern and Piping Plover experts, in particular.

MSHA (Mine Safety and Health Administration). In 2010, the TPCP provided MSHA-approved mine safety training (with endorsement for scientific workers) for all individuals working with terns and plovers on sand and gravel mines in the Lower Platte and Loup Rivers. We also provided MSHA training to the tern and plover monitoring personnel working with the Platte River Recovery Implementation Program. This training is mandated by the United States Department of Labor 30 CFR Part 46 regulations.

Girl Scouts-Spirit of Nebraska Camp Maha sandbar restoration project. In cooperation with the Girl Scouts-Spirit of Nebraska Camp Maha and Camp Catron, the USFWS Nebraska Partners for Fish and Wildlife Program (K. Dinan and K. Schroeder), and NGPC, we initiated a project to restore a sandbar in the Lower Platte River owned by Camp Maha (near Papillion, Cass County, NE). We had hoped to clear the sandbar of vegetation in August-September 2010, but continued high river flows prevented access to the sandbar by heavy equipment.



Outreach

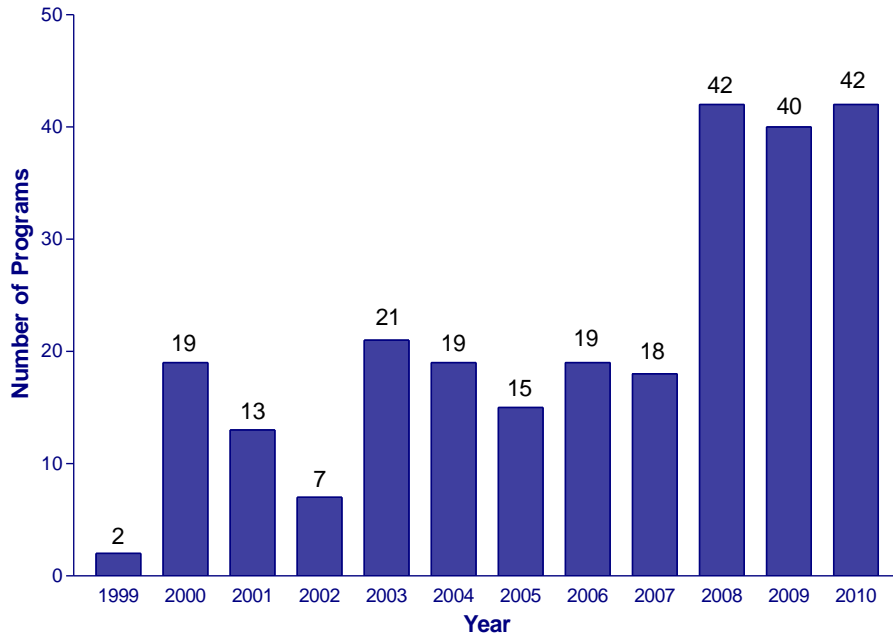
An important part of our mission to protect Interior Least Terns and Piping Plovers involves outreach. The TPCP is an important member of Nebraska's conservation and environmental education community. We are frequently called upon to give presentations, assist with symposia, workshops and festivals, participate in workgroups, and serve on committees. While the majority of our outreach efforts are focused on terns and plovers in Nebraska's Lower Platte River, we appreciate that we play a broader role in improving environmental literacy locally, regionally, and nationally. We take advantage of every opportunity to reach as many different constituencies as possible with our message of common-sense conservation.

Essential to the mission of the Tern and Plover Conservation Partnership is the continued growth of our outreach program. The number of adults and children that we are able to reach across the state has grown tremendously over the past three years. The TPCP is now one of the go-to programs in Nebraska's environmental education community. The TPCP has evolved from being an organization that needed to seek out events to participate in to one that receives a continuous stream of requests for participation. It is very gratifying for us to meet people who know what the TPCP does and who commend us for our work.

The Tern and Plover Conservation Partnership is serving as the local host for a joint meeting of three ornithological societies. The Association of Field Ornithologists, Wilson Ornithological Society, and Cooper Ornithological Society annual conference will be held at the Younes Conference Center in Kearney, NE from 9 – 13 March 2011. The boards of the Ornithological Societies of North America (OSNA) and Nebraska Bird Partnership will also be meeting during this conference. A tern and plover symposium, organized by Dan Catlin from Virginia Tech University, will substitute for the annual Nebraska Tern and Plover Meeting in 2011 (that meeting will return in 2012).



TPCP Outreach Programs



Participants in TPCP Outreach Programs

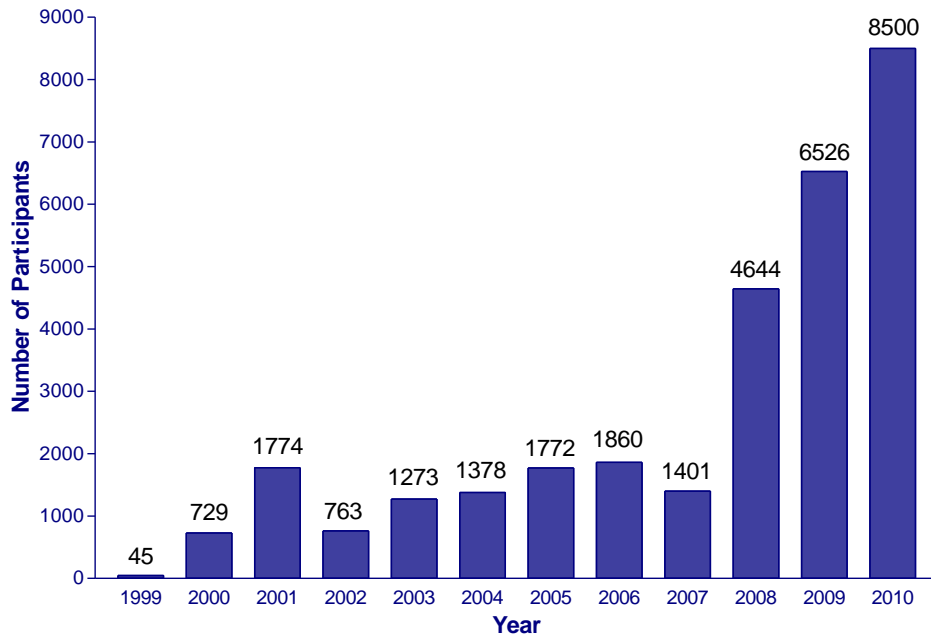
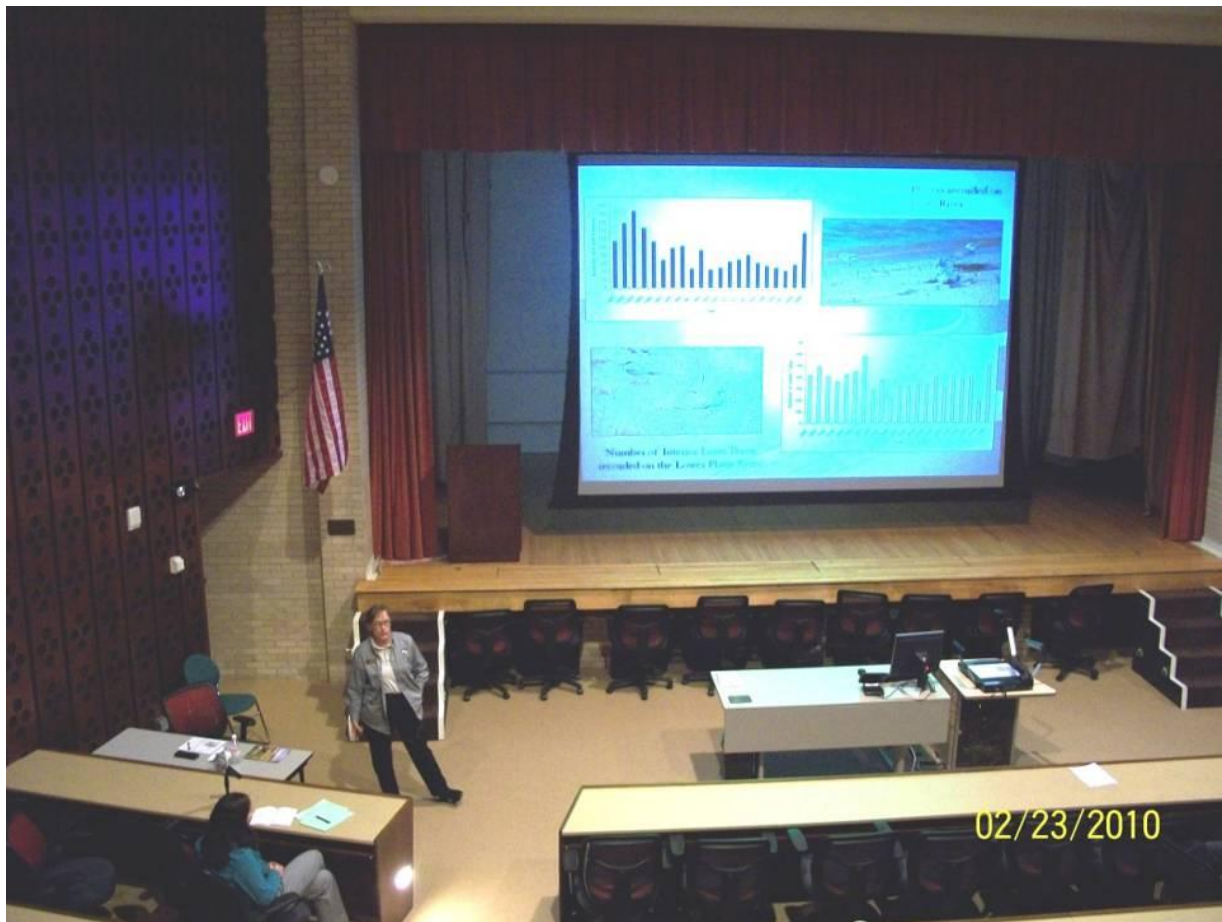


Figure 22. Number of programs delivered by TPCP Outreach Program 1999 – 2010 (top) and number of participants in TPCP Outreach Programs 1999 – 2010 (bottom). These include only the programs scheduled through the TPCP Outreach Coordinator; we frequently deliver impromptu presentations.

Nebraska Interior Least Tern and Piping Plover Meeting

Over 60 people participated in the fourth annual Nebraska Tern and Plover meeting on Tuesday, 23 February 2010 in Hardin Hall on the University of Nebraska East Campus. Participants hailed from eight states including Nebraska, Idaho, Minnesota, Michigan, North Dakota, South Dakota, Oregon, and Virginia. Representatives from the American Bird Conservancy, Central Nebraska Public Power and Irrigation District, Central Platte Natural Resources District, Grand Valley State University, HDR Inc., Lower Platte River Corridor Alliance, Nebraska Bird Partnership, Nebraska Breeding Bird Atlas, Nebraska Environmental Trust, Nebraska Game and Parks Commission, Nebraska Public Power District, Dig-It Landscapes, Platte River Recovery Implementation Program, Tern and Plover Conservation Partnership, The Nature Conservancy, UNL School of Natural Resources, U.S. Army Corps of Engineers, U.S. Department of Agriculture – APHIS, U.S. Fish and Wildlife Service, U.S. Geological Survey, and Virginia Tech University were present.

All presentations were videotaped and are available for viewing on our website (<http://ternandplover.unl.edu>).



Mary Bomberger Brown – Hardin Hall Auditorium

2010 Nebraska Least Tern and Piping Plover Meeting

9:30-10:45	Registration	1st Floor Lobby	4:00	Sandbar Habitat	<i>Joel Jorgensen</i> <i>NGPC</i>
9:30-10:30	Poster Presentation	2nd Floor Lobby	4:30	Foraging ecology of least terns and piping plovers nesting on Central Platte River sandpits and sandbars	<i>Mark Sherfy</i> <i>USGS</i>
9:30-10:30	Discussion of monitoring and recording methods	2nd Floor Lobby			
10:45	Welcome Mark Kuzila—UNL Joel Jorgensen—NGPC	Auditorium	5:00	River Reports ♦ 2009 Adult Census and Productivity of Least Terns and Piping Plovers on the Missouri River—Nebraska ♦ Niobrara Update ♦ Central Platte Update ♦ Lake McConaughy Update ♦ Loup River Update ♦ Lower Platte and Elkhorn Update	<i>Greg Pavelka</i> <i>USACE</i> <i>Stephen Wilson</i> <i>NPS</i> <i>Dave Baasch</i> <i>Headwaters</i> <i>Mark Peyton</i> <i>CNPPID</i> <i>Ben Wheeler</i> <i>NGPC</i> <i>Mary Bomberger</i> <i>Brown</i> <i>TPCP</i>
11:00	“A preliminary individual-based model of Least Tern nest site selection” Casey Lott, Stephen Railsback, and Collin Sheppard	<i>Casey Lott</i> <i>ABC</i>			
11:30	Planning for the 2011 International Census <i>(via telelink)</i>	<i>Elise Elliott-Smith</i> <i>USGS</i>			
12:00	Least Tern 5 year Review	<i>Jane Ludwin</i> <i>USFWS</i>			
12:30-1:15	Lunch* *Free will donations gladly accepted.	2nd Floor Lobby	5:45	Closing	
1:30	Piping Plover 5 year Review	<i>Carol Aron</i> <i>USFWS</i>	6:00	Tern and Plover Conservation Partnership’s 10th Anniversary Celebration hors d’oeuvres & cake	2nd Floor Lobby
2:00	“Predicting Management Implications on the Lower Platte River, Nebraska, for Interior Least Tern and Piping Plover: a Practical Application of a Quantitative Model”	<i>Jamie McFadden</i> <i>UNL</i>			
2:30	Great Lakes Piping Plovers	<i>Anna Young</i> <i>GVSU</i>			
3:00	Great Lakes	<i>Erin Roche</i> <i>UMinn</i>			
3:30	“Piping plover population dynamics on the Gavins Point Reach of the Missouri River” by Joy Felio, Dan Catlin, Jim Fraser, Jonathan Cohen <i>(via telelink)</i>	<i>Joy Felio</i> <i>Virginia Tech</i>			

ABC—American Bird Conservancy
 CNPPID—Central Nebraska Public Power and Irrigation District
 CPNRD—Central Platte Natural Resources District
 GVSU—Grand Valley State University
 FWS—US Fish and Wildlife Service
 NGPC—Nebraska Game and Parks Commission
 NPPD—Nebraska Public Power District
 NPS—National Park Service
 PRRIP—Platte River Recovery and Implementation Program
 TPCP—Tern and Plover Conservation Partnership
 UMinn—University of Minnesota
 UNL—University of Nebraska-Lincoln
 USACE—US Army Corps of Engineers
 USGS—US Geological Survey

Attendance at the 4th Nebraska Tern and Plover Meeting, 23 February 2010

First Name	Last Name	Affiliation
Frank	Albrecht	Nebraska Game and Parks Commission
Carol	Aron	U.S. Fish and Wildlife Service Platte River Recovery and Implementation Program
Dave	Baasch	Tern and Plover Conservation Partnership volunteer
Elliott	Bedows	Tern and Plover Conservation Partnership
Mary	Bomberger Brown	U.S. Army Corps of Engineers
Gene	Bormann	Nebraska Environmental Trust
Mark	Brohman	UNL Emeritus Professor
Ron	Case	Nebraska Department of Roads
Zach	Cunningham	Central Platte Natural Resources District
Mark	Czaplewski	
Jim	Ducey	
Elise	Elliott-Smith	U.S. Geological Survey
Joy	Felio	Virginia Tech University
Mike	Fritz	Nebraska Game and Parks Commission
Dionne	Gioia	U.S. Department of Agriculture - APHIS
Carey	Grell	Nebraska Game and Parks Commission
Marty	Hamel	UNL School of Natural Resources
Jeremy	Hammen	UNL School of Natural Resources
Bob	Harms	U.S. Fish and Wildlife Service
Tim	Hiller	UNL School of Natural Resources
Julie	Huddle	UNL School of Natural Resources
Jim	Jenniges	Nebraska Public Power District
Joel	Jorgensen	Nebraska Game and Parks Commission

Michelle	Koch	Nebraska Game and Parks Commission
Jeanine	Lackey	U.S. Fish and Wildlife Service
Jane	Ledwin	U.S. Fish and Wildlife Service
Jill	Liske-Clark	Nebraska Bird Partnership
Casey	Lott	American Bird Conservancy
Scott	Luedtke	Nebraska Game and Parks Commission
Melissa	Marinovich	HDR Inc.
Sara	McClure	Lower Platte River Corridor Alliance
Jamie	McFadden	UNL School of Natural Resources
Nell	McPhillips	U.S. Fish and Wildlife Service
Wayne	Mollhoff	Nebraska Breeding Bird Atlas
Greg	Pavelka	U.S. Army Corps of Engineers
		Central Nebraska Public Power and Irrigation
Mark	Peyton	District
Diane	Pratt	Tern and Plover Conservation Partnership
Sarah	Rehme	UNL School of Natural Resources
Chad	Richardson	U.S. Department of Agriculture - APHIS
Scot	Rosendahl	U.S. Department of Agriculture - APHIS
Jeff	Runge	U.S. Fish and Wildlife Service
Melissa	Santiago	Nebraska Game and Parks Commission
Adam	Schapaugh	UNL School of Natural Resources
Rick	Schneider	Nebraska Game and Parks Commission
Mark	Sherfy	U.S. Geological Survey
Meghan	Sittler	Lower Platte River Corridor Alliance
		Platte River Recovery and Implementation
Chad	Smith	Program
Brooke	Stansberry	U.S. Fish and Wildlife Service
Sonya	Steckler	Nebraska Game and Parks Commission
Jared	Stirling	U.S. Army Corps of Engineers
Marilyn	Tabor	Nebraska Game and Parks Commission
Cynthia	Taylor	Owner - Dig-It Landscapes

Chris	Thody	Tern and Plover Conservation Partnership
Drew	Tyre	UNL School of Natural Resources
Garrett	Unrein	U.S. Department of Agriculture - APHIS
Rich	Walters	The Nature Conservancy
Ben	Wheeler	Nebraska Game and Parks Commission
Greg	Wingfield	U.S. Fish and Wildlife Service
Ricky	Woods	U.S. Department of Agriculture - APHIS
Anna	Young	Grand Valley State University
Ron	Zelt	U.S. Geological Survey



The internet and social media have become important tools in expanding our outreach program. Our website (<http://ternandplover.unl.edu>) is frequently updated with information about the Partnership; to date it has received 24,942 hits. According to *Google Analytics*, we have had visitors from 49 different countries to our website. The majority of the visits, approximately 80%, were from the U.S., but the fact that 20% of visits come from other countries suggests that we are starting to have an international impact. Our *YouTube* videos continue to generate interest in the Partnership. “Respect the Signs, Respect the Birds” has been viewed 3,125 times, “Plover at Nest” has been viewed 1,717 times, and “Points about Plovers” has been viewed 689 times. We have 550 friends on our Facebook page. We use our Facebook page to generate interest in a variety of issues related to terns and plovers (<http://ternandplover.unl.edu/tern%20and%20plover%20facebook.htm>).

Five Nines Technology Group of Lincoln, NE and Ben Wheeler (NGPC) helped us launch “TernCam” in 2010, our first venture into the “CritterCam” market; the live video feed was streamed to the Partnership and the UNL School of Natural Resources websites. We focused the camera on an Interior Least Tern nest located at a sand and gravel mine near Ord, NE. Three chicks hatched from the three eggs in the nest. We captured images from the video and assembled them into a rotating slideshow available on the “TernCam” section of our website. These sorts of “cams” are popular with the general public, and we saw a significant spike in activity on our website when “TernCam” went live. Stimulated by the success of “TernCam”, the organizers of the Watchable Wildlife Conference in Kearney, NE included a symposium titled “Eyes on Nature: Using Technology to Advance the Experience (led by Aaron Clark and Sus Weerasinghe from Five Nines Technology Group, www.gonines.com and Ben Wheeler, NGPC), which featured our “TernCam” equipment. Next year we plan to focus the camera on both Piping Plover and Interior Least Tern nests.



Figure 23. Photograph captured from the “TernCam” video stream.

Tern and Plover Watch 2010. Ben Wheeler, coordinating wildlife biologist with the Nebraska Game and Parks Commission (Central Loess Hills BUL, Ord, NE), organized Tern and Plover Watch 2010 on the Loup River. The Watch called upon local volunteers to visit bridges over the river once per week and count the number of terns and plovers they saw in the area.

The following is a summary of our 2010 outreach program.



Programs for the General Public

Ashland-Greenwood Family Nature Nights, Ashland, NE
Becoming an Outdoors Woman (BOW), Halsey, NE
Cavett Elementary Nature Club, Lincoln NE
Central Loess Hills Natural History Series, Broken Bow, NE
Clinton Community Learning Center, Lincoln, NE
Conestoga Family Nature Nights, Murray, NE
Cub Scout troop presentations, Lincoln, NE
Dimensions Family Nature Nights, Lincoln, NE
Durham History Museum, Omaha, NE
Durham Museum Teacher's Night Out, Omaha, NE
Earth Day Celebration at Antelope Park, Lincoln, NE
Earth Wellness Festival, Lincoln, NE
Everett Family Nature Nights, Lincoln, NE
Flying Higher Camp, Rowe Audubon Sanctuary, Gibbon, NE
Fort Kearny Expo, Minden, NE
Fremont Ecofair, Fremont, NE
Groundwater Festival, Grand Island, NE
Hartley Community Learning Center, Lincoln, NE

Hartley Family Nature Nights, Lincoln, NE
Holmes Family Nature Nights, Lincoln, NE
Lincoln Center Kiwanis Club, Agriculture and Environment, Lincoln, NE
Lower Platte River Corridor Alliance Kayak Tour, Venice, NE
Lower Platte River Corridor Alliance Water Quality Open, South Bend, NE
Lueschen Birders, Norfolk, NE
Maxey Family Nature Nights, Lincoln, NE
McPhee Family Nature Nights, Lincoln, NE
Nebraska Nature and Visitor Center, Alda, NE
Platte River State Park Expo, South Bend, NE
Prescott Family Nature Nights, Lincoln, NE
RWC Wild Experience Room, Kearney, NE
Sensory Safari at Lincoln Children's Zoo, Lincoln, NE
Sheridan Family Nature Nights, Lincoln, NE
Southeast Community College Career Expo, Lincoln, NE
Twilight on the Tallgrass, Lincoln, NE
Two Rivers State Park Water Festival, Lincoln, NE
Wachiska Audubon Crane Trip, Alda, NE
Waterfest, Lincoln, NE
Westminister Presbyterian Environment Fair, Lincoln, NE



Homeowners' Association Presentations

Big Sandy, Cedar Creek, Lake Socorro, Mallard Landing, Riverview Shores

University of Nebraska-Based Education Programs

Big Red Summer Camp
Career Day at School of Natural Resources
Career Day for Animal Science Department
EnvironMentors
Nebraska Master Naturalist
NaturePalooza at Morrill Hall
Sunday with a Scientist at Morrill Hall
UNL Big Event
UNL Volunteer Service Learning Fair
Weatherfest



Education-Curriculum Development Activities

State of Nebraska Environmental Literacy Plan
Informal Educators of Lincoln, Nebraska Network
Iowa Western Community College Environmental Studies
Nebraska Alliance of Conservation and Environment Educators
Nebraska Bird Library, Nebraska Bird Partnership
Project BEAK Bird Resource Database development, Nebraska Bird Partnership

Conferences and Symposia

American Ornithologists' Union, San Diego, CA
Atlantic Coast Tern and Plover meeting, NCTC, Shepherdstown, WV
Lower Platte River Corridor Alliance Conceptual Modeling, Lincoln, NE
Lower Platte River Corridor Alliance River Summit, Ashland, NE
Missouri River Natural Resources Committee Biological Opinion Forum, Nebraska City, NE
Nebraska Alliance for Conservation and Environment Educators, Ashland, NE
Nebraska Invasive Species Conference, Lincoln, NE
Rivers and Wildlife Celebration, Kearney, NE
Watchable Wildlife Conference, Kearney, NE

Professional Committees and Workgroups

Communication, Conservation, Science Advisory and Education workgroups, Nebraska Bird Partnership
Nebraska Environmental Trust Technical Advisory Committee
PACE (Planning, Aggregate, Community, Environment)
Platte River Recovery Implementation Program
Rivers and Wildlife Celebration Planning Committee
SNR Communication, Managers, Social, Staff Advisory and Sustainability committees, University of Nebraska
Steering Committee, Nebraska Bird Partnership
Wachiska Audubon Society Board of Directors and Education Committee

Miscellaneous

Earth2Lincoln. Outreach Coordinator Chris Thody hosts this 30-minute talk show on KZUM community radio on one Monday per month (6:00 – 6:30 pm). Guests in 2010 included Mark Brohman (Nebraska Environmental Trust programs), Linda Brown (Sandhill Crane migration along the Platte River), Mary Bomberger Brown (Tern and Plover Conversation Partnership), Katie DeLashmutt (University of Nebraska student opportunities), Nancy Furman (Pioneers Park Nature Center), Deb Hauswald (Spring Creek Prairie), Harry Heafer (Nebraska Environmental Literacy Plan and No Child Left Inside legislation), Paul Johnsgard (Sandhill Crane migration along the Platte River), Joel Jorgensen (Peregrine Falcons nesting on the Nebraska State Capitol Building and non-game birds), Brandy Lively (Nebraska Master naturalist program), Annabel Lee Major (Nebraska Master naturalist program), Sue Ellen Pegg (University of Nebraska student opportunities), Kristal Stoner (Nebraska Nongame Wildlife Check-off fund and Teaming with Wildlife), and Don Wilhite (sustainability and energy conservation at the University of Nebraska School of Natural Resources). Additional information is available at <http://earth2lincoln.blogspot.com>.

Nebraska State Fair 4-H. As we have for the past several years, the Partnership has coordinated the judging of the 4-H Wildlife exhibits at the Nebraska State Fair. For the first time, we saw an exhibit describing Piping Plovers nesting on sandbars in the Platte River; the exhibit was so good it was given a special commendation award. Apparently, the exhibitor attended one of our school presentations and was inspired to complete a project on plovers.



Friends of Pioneers Park Nature Center and City of Lincoln Watershed Management Division Artistic Rain Barrel Program. Outreach Coordinator Chris Thody painted a rain barrel with scenes from the Lower Platte River (complete with sandbar-nesting Interior Least Terns and Piping Plovers) for this annual program. The program helped educate people on the benefits of using rain barrels to improve water quality and to raise awareness of local organizations. The rain barrels were auctioned off with proceeds going to the Adventure and Extreme Nature Camp scholarship fund (the TPCP rain barrel sold for \$200).



Featured in media

- 2010. "Notes from the Christmas Count", UNL SNR video production (www.vimeo.com)
- 2010, "An Update on the Terns and Plovers Nesting on the Sand Pile at the Headworks", Loup Generator, Autumn.
- 2010, "Citizen Science in Action: the Christmas Bird Count", Prairie Fire, December.
- 2010, "Kayakers paddle on the Platte River to get a closer look", Lincoln Journal Star, 20 July.
- 2010, "Camera focuses on nesting tern" Omaha World Herald, 16 July (distributed on Associated Press network).
- 2010, NPR radio interview (Nebraska News with Perry Stoner) Tern and Plover Conservation Partnership, 16 – 17 February.
- 2010, "Awards and Honors", Scarlet Year in Review, 9 September.
- 2010, "From the Director's Desk", Friends of Morrill Hall, Mammoth, May.
- 2010, "Sunday with a Scientist Program Allows Families to Interact with Scientists, Explore New Topics Each Month", Friends of Morrill Hall-Mammoth, May.
- 2010, "Tern and Plover Conservation Partnership Celebrates 10 Years", Scarlet, 18 February.

- 2010, "Tern and plover conservation partnership celebrates 10th anniversary."
<http://thefencepost.com>, 24 February.
- 2010, "Tern and Plover Conservation Partnership", Water Currents (University of Nebraska School of Natural Resources Water Center publication), Spring.
- 2010, "Earth 2 Lincoln", KZUM community radio program, 89.3 FM-HD, Monday evenings, 6-6:30pm.
- 2009 – 2010, Nebraska Environmental Trust Channel 10-11 (KOLN-KGIN) television commercial.

Fundraising

- AGRI/NRES 103 Recitation (stipend)
- www.goodsearch.com and www.goodshop.com (donations)
- Tern and plover product sales (t-shirts, tote bags, hats, tumblers, plush animals) in SNR
 Maps and More Store and Nebraska Nature and Visitors' Center (Alda, NE)
- Photographs with Pebbles the Giant Plover (donations)
- IMBTA and GBEPa surveys (contracts)
- Preferred Rocks of Genoa (stipend)
- Seminar (honoraria)

Grants

- Nebraska Environmental Trust "Advancing Tern and Plover Common Sense Conservation into the Future", 3rd year operating funds allocated
- Nebraska Game and Parks Commission State Wildlife Grant "Restoring Interior Least Tern and Piping Plover Populations by Restoring Lower Platte River Sandbar Habitat", grant awarded full funding
- Nebraska Partnership for All-Bird Conservation "The Tern and Plover Conservation Partnership: Habitat Restoration and Public Education Advances Common Sense Conservation in Nebraska", grant awarded full funding
- Nebraska Environmental Trust "Implementing A Science-Based Adaptive Management Plan for Interior Least Tern and Piping Plovers along the Lower Platte River, Nebraska" proposal submitted

Publications

Brown, M.B., and J.G. Jorgensen. 2010. Observations of Piping Plovers (*Charadrius melodus*) color banded in Nebraska and re-sighted on the United States Gulf Coast. Nebraska Bird Review 78: 30 – 34.

Brown, M.B., J. Dinan, R.J. Held, R.J. Johnson, J.G. Jorgensen, J. Lackey, J.F. Marcus, and C.M. Thody. in review. A partnership model for sustainable threatened and endangered species conservation in Nebraska: the Tern and Plover Conservation Partnership. Wader Study Group Bulletin.

Brown, M.B., and J.G. Jorgensen. in prep. A review of Interior Least Tern and Piping Plover management, conservation and recovery on the Lower Platte River, Nebraska: a foundation for implementing an adaptive management framework.

Jorgensen, J.G., M. B. Brown, and A.J. Tyre. in review. Channel width and Interior Least Tern and Piping Plover nesting incidence on the Lower Platte River, Nebraska. Great Plains Research.

Thody, C.M. 2010. Piping Plover. Trail Tails 16: 6.

Thody, C.M. 2010. Least Tern. Trail Tails 16: 7.

Thody, C.M., and J. Swerczek. 2010. What laws protect wildlife? Trail Tails. 16: 4 – 5.

Reviewers

Auk (American Ornithologists Union)
Nebraska Environmental Trust grants
United States Geological Survey
Wilson Journal of Ornithology

“...so now that man is no longer its deadly enemy, there is little to check the species from repopulating its breeding haunts in its former numbers...”

A.C. Bent, Life Histories of North American Shorebirds
1929

Special thanks to Lauren Dinan, Diane Pratt, and Sonya Steckler for helping us monitor and protect terns and plovers in 2010...we're sure the birds are grateful for their help.



Appendix A. Piping Plover color band combinations observed and placed on birds at off-river sites in 2008, 2009 and 2010.

Date Banded	BAND	AGE	UR	LR	UL	LL	TYPE	SITE	COUNTY
5/30/2008	1981-25701	Adult	LBF	Red	metal	Red	Housing Development	Socorro Lake	Colfax
6/2/2008	1981-25702	Adult	LBF	Red	metal	Green	Sand & Gravel mine	Shady Lake Road	Platte
5/31/2008	1981-25703	Adult	LBF	Red	metal	Yellow	Housing Development	Riverview Shores	Dodge
6/2/2008	1981-25704	Adult	LBF	Green	metal	Green	Sand & Gravel mine	Riverside	Saunders
6/2/2008	1981-25705	Adult	LBF	Green	metal	Orange	Housing Development	Big Sandy	Saunders
6/2/2008	1981-25706	Adult	LBF	Green	metal	Black	Housing Development	Big Sandy	Saunders
6/3/2008	1981-25707	Adult	LBF	Green	metal	Gray	Sand & Gravel mine	Waterloo	Douglas
6/3/2008	1981-25708	Adult	LBF	Green	metal	Red/Red	Sand & Gravel mine	Waterloo	Douglas
6/3/2008	1981-25709	Adult	LBF	Green	metal	Red/Yellow	Sand & Gravel mine	Pleasure Lake	Douglas
6/3/2008	1981-25710	Adult	LBF	Green	metal	Red/Green	Sand & Gravel mine	Pleasure Lake	Douglas
6/5/2008	1981-25711	Adult	LBF	Green	metal	Red/Orange	Housing Development	Riverview Shores	Dodge
6/5/2008	1981-25712	Adult	LBF	Green	metal	Red/Black	Housing Development	Riverview Shores	Dodge
6/5/2008	1981-25713	Adult	LBF	Green	metal	Red/Gray	Housing Development	Riverview Shores	Dodge
6/16/2008	1981-25715	Adult	LBF	Green	metal	Yellow/Red	Housing Development	Socorro Lake	Colfax
6/16/2008	1981-25716	Adult	LBF	Green	metal	Yellow/Yellow	Housing Development	Riverview Shores	Dodge
6/17/2008	1981-25717	Adult	LBF	Green	metal	Yellow/Green	Sand & Gravel mine	W Fremont	Dodge
6/19/2008	1981-25718	Adult	LBF	Green	metal	Yellow/Orange	Housing Development	Big Sandy	Saunders
7/26/2008	1981-25719	Adult	LBF	Green	metal	Yellow/Black	Sand & Gravel mine	Mallard	Douglas
7/26/2008	1981-25720	Adult	LBF	Green	metal	Yellow/Gray	Sand & Gravel mine	Mallard	Douglas
7/5/2008	1981-25725	Chick	LBF	Green		metal	Housing Development	Riverview Shores	Dodge
7/5/2008	1981-25726	Chick	LBF	Green	metal	Green/Red	Housing Development	Riverview Shores	Dodge
7/7/2008	1981-25731	Chick	LBF	Green	metal	Orange/Red	Sand & Gravel mine	Louisville Lakes	Sarpy
7/7/2008	1981-25732	Chick	LBF	Green	metal	Orange/Yellow	Sand & Gravel mine	Louisville Lakes	Sarpy
7/7/2008	1981-25733	Chick	LBF	Green	metal	Orange/Green	Sand & Gravel mine	Louisville Lakes	Sarpy
7/7/2008	1981-25735	Chick	LBF	Green	metal	Orange/Orange	Sand & Gravel mine	Louisville Lakes	Sarpy
7/7/2008	1981-25736	Adult	LBF	Green	metal	Black/Orange	Sand & Gravel mine	Melia	Sarpy
7/11/2008	1981-25746	Adult	LBF	Green	metal	Orange/Black	Sand & Gravel mine	Louisville Lakes	Sarpy
7/11/2008	1981-25748	Chick	LBF	Green	metal	Orange/Gray	Sand & Gravel mine	Waterloo	Douglas

7/14/2008	1981-25758	Chick	LBF	Green	metal	Black/Red	Housing Development	Socorro Lake	Colfax
7/25/2008	1981-25776	Chick	LBF	Green	metal	Black/Black	Sand & Gravel mine	Louisville Lakes	Sarpy
7/25/2008	1981-25777	Chick	LBF	Green	metal	Black/Gray	Sand & Gravel mine	Louisville Lakes	Sarpy
5/22/2009	2411-00601	Adult	metal	Green/Red	LBF	Red/Red	Housing Development	Riverview Shores	Dodge
5/22/2009	2411-00602	Adult	metal	Red/Green	LBF	Yellow/Gray	Housing Development	Riverview Shores	Dodge
5/22/2009	2411-00603	Adult	metal	Red/Green	LBF	Red/Gray	Housing Development	Riverview Shores	Dodge
5/22/2009	2411-00604	Adult	metal	Red/Green	LBF	Green/Gray	Housing Development	Riverview Shores	Dodge
5/26/2009	2411-00605	Adult	metal	Red/Green	LBF	Black/Gray	Sand & Gravel mine	Thomas Lakes	Saunders
5/26/2009	2411-00606	Adult	metal	Red/Green	LBF	Gray/Red	Housing Development	Big Sandy	Saunders
5/29/2009	2411-00607	Adult	metal	Red/Green	LBF	Gray/Yellow	Sand & Gravel mine	Waterloo	Douglas
5/29/2009	2411-00608	Adult	metal	Red/Green	LBF	Gray/Green	Sand & Gravel mine	W Fremont	Dodge
5/29/2009	2411-00609	Chick	metal	Red/Green	LBF	Gray/Black	Housing Development	Big Sandy	Saunders
5/29/2009	2411-00610	Chick	metal	Red/Green	LBF	Gray/Gray	Housing Development	Big Sandy	Saunders
6/1/2009	2411-00611	Adult	metal	Red/Yellow	LBF	Red/Gray	Sand & Gravel mine	NE Fremont	Dodge
6/1/2009	2411-00612	Adult	metal	Red/Yellow	LBF	Yellow/Gray	Housing Development	Socorro Lake	Colfax
6/2/2009	2411-00613	Adult	metal	Red/Yellow	LBF	Green/Gray	Housing Development	Riverview Shores	Dodge
6/2/2009	2411-00614	Adult	metal	Red/Yellow	LBF	Black/Gray	Housing Development	Riverview Shores	Dodge
6/2/2009	2411-00615	Adult	metal	Red/Yellow	LBF	Gray/Red	Housing Development	Riverview Shores	Dodge
6/2/2009	2411-00616	Adult	metal	Red/Yellow	LBF	Gray/Yellow	Housing Development	Riverview Shores	Dodge
6/2/2009	2411-00615	Adult	metal	Red/Yellow	LBF	Gray/Green	Housing Development	Riverview Shores	Dodge
6/15/2009	2411-00618	Chick	metal	Red/Yellow	LBF	Gray/Black	Housing Development	Riverview Shores	Dodge
6/15/2009	2411-00619	Chick	metal	Red/Yellow	LBF	Gray/Gray	Housing Development	Riverview Shores	Dodge
6/22/2009	2411-00620	Adult	metal	Red/Red	LBF	Red/Red	Sand & Gravel mine	Louisville Lakes	Sarpy
6/22/2009	2411-00621	Chick	metal	Red/Red	LBF	Red/Yellow	Housing Development	Big Sandy	Saunders
6/22/2009	2411-00622	Chick	metal	Red/Red	LBF	Red/Green	Housing Development	Big Sandy	Saunders
6/23/2009	2411-00624	Chick	metal	Red/Red	LBF	Red/Black	Sand & Gravel mine	W Fremont	Dodge
6/23/2009	2411-00625	Chick	metal	Red/Red	LBF	Red/Gray	Sand & Gravel mine	W Fremont	Dodge
6/23/2009	2411-00626	Chick	metal	Red/Red	LBF	Yellow/Red	Sand & Gravel mine	NE Fremont	Dodge
6/23/2009	2411-00627	Chick	metal	Red/Red	LBF	Yellow/Yellow	Sand & Gravel mine	NE Fremont	Dodge
7/6/2009	2411-00646	Chick	metal	Red/Red	LBF	Yellow/Black	Sand & Gravel mine	Louisville Lakes	Sarpy
7/6/2009	2411-00647	Chick	metal	Red/Red	LBF	Yellow/Gray	Sand & Gravel mine	Louisville Lakes	Sarpy
7/7/2009	2411-00652	Chick	metal	Red/Red	LBF	Green/Red	Housing Development	Riverview Shores	Dodge

7/7/2009	2411-00653	Chick	metal	Red/Red	LBF	Green/Yellow	Housing Development	Riverview Shores	Dodge
7/13/2009	2411-00669	Adult	metal	Red/Red	LBF	Green/Green	Sand & Gravel mine	Thomas Lakes	Saunders
7/13/2009	2411-00675	Adult	metal	Red/Red	LBF	Green/Black	Sand & Gravel mine	Thomas Lakes	Saunders
7/20/2009	2411-00686	Chick	metal	red/red	LBF	Green/Gray	Sand & Gravel mine	Thomas Lakes	Saunders
7/20/2009	2411-00687	Chick	metal	Red/Red	LBF	Black Red	Sand & Gravel mine	Thomas Lakes	Saunders
7/24/2009	8011-64466	Chick	metal	Red/Red	LBF	Black/Yellow	Sand & Gravel mine	Thomas Lakes	Saunders
5/24/2010	2211-01101	Adult	metal	Red/Red	LBF	Black/Green	Housing Development	Big Sandy	Saunders
5/24/2010	2211-01102	Adult	metal	Red/Red	LBF	Black/Black	Housing Development	Riverview Shores	Dodge
5/24/2010	2211-01103	Adult	metal	Red/Red	LBF	Black/Gray	Housing Development	Riverview Shores	Dodge
5/24/2010	2211-01104	Adult	metal	Red/Red	LBF	Gray/Red	Housing Development	Riverview Shores	Dodge
5/27/2010	2211-01105	Adult	metal	Red/Red	LBF	Gray/Yellow	Sand & Gravel Mine	W Fremont	Saunders
5/27/2010	2211-01106	Adult	metal	Red/Red	LBF	Gray/Green	Housing Development	Riverview Shores	Dodge
6/1/2010	2211-01107	Chick	metal	Red/Red	LBF	Gray/Black	Sand & Gravel Mine	W Fremont	Saunders
6/1/2010	2211-01108	Chick	metal	Red/Red	LBF	Gray/Gray	Sand & Gravel Mine	W Fremont	Saunders
6/1/2010	2211-01109	Chick	metal	Green/Green	LBF	Red/Red	Sand & Gravel Mine	W Fremont	Saunders
6/1/2010	2211-01110	Chick	metal	Green/Green	LBF	Red/Yellow	Sand & Gravel Mine	NE Fremont	Saunders
6/1/2010	2211-01111	Chick	metal	Green/Green	LBF	Red/Green	Sand & Gravel Mine	NE Fremont	Saunders
6/1/2010	2211-01112	Chick	metal	Green/Green	LBF	Red/Black	Sand & Gravel Mine	NE Fremont	Saunders
6/1/2010	2211-01113	Chick	metal	Green/Green	LBF	Red/Gray	Housing Development	Riverview Shores	Dodge
6/1/2010	2211-01114	Chick	metal	Green/Green	LBF	Yellow/Yellow	Housing Development	Riverview Shores	Dodge
6/1/2010	2211-01115	Chick	metal	Green/Green	LBF	Yellow/Green	Housing Development	Riverview Shores	Dodge
6/1/2010	2211-01116	Chick	metal	Green/Green	LBF	Yellow/Black	Housing Development	Riverview Shores	Dodge
6/3/2010	2211-01117	Adult	metal	Green/Green	LBF	Yellow/Gray	Housing Development	Socorro Lake	Colfax
6/4/2010	2211-01118	Chick	metal	Green/Green	LBF	Green/Red	Housing Development	Riverview Shores	Dodge
6/4/2010	2211-01119	Adult	metal	Green/Green	LBF	Green/Yellow	Housing Development	Riverview Shores	Dodge
6/4/2010	2211-01122	Chick	metal	Green/Green	LBF	Green/Green	Housing Development	Riverview Shores	Dodge
6/4/2010	2211-01120	Chick	metal	Green/Green	LBF	Green/Black	Housing Development	Riverview Shores	Dodge
6/4/2010	2211-01121	Chick	metal	Green/Green	LBF	Green/Gray	Housing Development	Riverview Shores	Dodge
6/14/2010	2211-01123	Chick	metal	Orange/Orange	LBF	Green/Green	Housing Development	Socorro Lake	Colfax
6/14/2010	2211-01124	Chick	metal	Green/Green	LBF	Black/Red	Housing Development	Socorro Lake	Colfax
6/14/2010	2211-01125	Chick	metal	Green/Green	LBF	Black/Yellow	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01126	Chick	metal	Green/Green	LBF	Black/Green	Housing Development	Riverview Shores	Dodge

6/15/2010	2211-01127	Chick	metal	Green/Green	LBF	Black/Black	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01128	Chick	metal	Green/Green	LBF	Black/Gray	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01129	Chick	metal	Green/Green	LBF	Gray/Red	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01130	Chick	metal	Green/Green	LBF	Gray/Yellow	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01131	Chick	metal	Green/Green	LBF	Gray/Black	Housing Development	Riverview Shores	Dodge
6/15/2010	2211-01132	Chick	metal	Green/Green	LBF	Gray/Gray	Housing Development	Riverview Shores	Dodge
6/18/2010	2211-01133	Chick	metal	Yellow/Red	LBF	Red/Red	Housing Development	Mallard	Douglas
6/18/2010	2211-01134	Chick	metal	Yellow/Red	LBF	Red/Yellow	Housing Development	Mallard	Douglas
6/18/2010	2211-01135	Chick	metal	Yellow/Red	LBF	Red/Green	Housing Development	Mallard	Douglas
6/18/2010	2211-01136	Chick	metal	Yellow/Red	LBF	Red/Black	Housing Development	Mallard	Douglas
6/18/2010	2211-01137	Chick	metal	Yellow/Red	LBF	Red/Gray	Housing Development	Mallard	Douglas
6/18/2010	2211-01138	Chick	metal	Yellow/Red	LBF	Yellow/Red	Housing Development	Mallard	Douglas
6/22/2010	2211-01139	Chick	metal	Yellow/Red	LBF	Yellow/Yellow	Housing Development	Riverview Shores	Dodge
6/22/2010	2211-01140	Chick	metal	Yellow/Red	LBF	Yellow/Green	Housing Development	Riverview Shores	Dodge
6/22/2010	2211-01141	Chick	metal	Yellow/Red	LBF	Yellow/Black	Housing Development	Riverview Shores	Dodge
6/22/2010	2211-01142	Chick	metal	Yellow/Red	LBF	Yellow/Gray	Housing Development	Riverview Shores	Dodge
6/22/2010	2211-01143	Chick	metal	Yellow/Red	LBF	Green/Red	Housing Development	Riverview Shores	Dodge
6/28/2010	2211-01155	Chick	metal	Yellow/Red	LBF	Green/Yellow	Sand & Gravel Mine	NE Fremont	Saunders
6/28/2010	2211-01156	Chick	metal	Yellow/Red	LBF	Green/Green	Sand & Gravel Mine	NE Fremont	Saunders
6/28/2010	2211-01157	Chick	metal	Yellow/Red	LBF	Green/Black	Sand & Gravel Mine	NE Fremont	Saunders
6/28/2010	2211-01158	Chick	metal	Yellow/Red	LBF	Green/Gray	Sand & Gravel Mine	NE Fremont	Saunders
7/2/2010	2211-01173	Chick	metal	Yellow/Red	LBF	Black/Red	Sand & Gravel Mine	Genoa	Nance
7/2/2010	2211-01174	Chick	metal	Yellow/Red	LBF	Black/Yellow	Sand & Gravel Mine	Genoa	Nance
7/7/2010	2211-01184	Chick	metal	Yellow/Red	LBF	Black/Green	Housing Development	Riverview Shores	Dodge
7/7/2010	2211-01185	Chick	metal	Yellow/Red	LBF	Black/Black	Housing Development	Riverview Shores	Dodge
7/7/2010	2211-01186	Chick	metal	Yellow/Red	LBF	Black/Gray	Housing Development	Riverview Shores	Dodge
7/8/2010	2211-01188	Chick	metal	Yellow/Red	LBF	Gray/Red	Sand & Gravel Mine	Melia	Sarpy
7/8/2010	2211-01195	Chick	metal	Yellow/Red	LBF	Gray/Yellow	Sand & Gravel Mine	Riverside	Saunders
7/8/2010	2211-01198	Adult	metal	Yellow/Red	LBF	Gray/Green	Sand & Gravel Mine	Riverside	Saunders
7/13/2010	2421-37420	Chick	metal	Yellow/Red	LBF	Gray/Black	Housing Development	Riverview Shores	Dodge